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SELECTED WATER RESOURCES ABSTRACTS

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DECEMBER 1988

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A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1989.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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SURFACE RUN-OFF POLLUTION DURING THAWS AND HEAVY RAINFALL IN AGRICULTURAL CATCHMENT BASINS (THE CARPATHIAN PLATEAU, POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10363

SOIL AND WATER LOSSES IN A LOW INTENSITY RAINFALL REGION IN IRAQ,
Agriculture and Water Resources Research Centre, Baghdad (Irag).
For primary bibliographic entry see Field 2B.
W88-10400

CONTRIBUTION OF SOIL MOISTURE STORAGE TO THE WATER BALANCES OF UPLAND FORESTED AND GRASSLAND CATCHMENTS,
Institute of Hydrology, Powys (Wales).
J. A. Hudson.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 3, p 289-309, June 1988. 8 fig, 3 tab, 34 ref.

Descriptors: *Soil water, *Hydrologic budget, *Forest watersheds, *Grasslands, *Storage, Seasonal storage, Watersheds, Catchment areas, Wales, Drought, Snow, Precipitation, Evaporation, Evaporation rate, Seasonal variation, Mathematical analysis, Vegetation, Transpiration, Watershed management.

Soil moisture was measured on the Plynlimon catchments, mid Wales, by neutron scattering using networks of access tubes, as a means of estimating the changes in catchment storage for inclusion in the water balance. Reduced networks were used from 1974 to 1982, following an early assessment of their contribution to the water balance from 1970 to 1973. This study assesses the contribution of soil moisture change to both the annual and within-year water balances of the predominantly forested Severn and grassland Wye catchments, during a period of more extreme conditions of wetness, drought, and snowfall. Soil moisture has a significant impact on the water balance, but with a tendency to give evaporation less than the Penman E sub T in the summer months and the converse in the winter, a discrepancy explained by the movement of water into and out of stores that are not measured by the soil moisture networks. Losses by evaporation from the forest and grassland areas are estimated and the physical and biological implications for water resources and forestry are discussed. (Author's abstract)
W88-10402

ASSESSMENT OF A SIMPLE SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF DISSOLVED ORGANIC CARBON IN FRESHWATERS,
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SATELLITE REMOTE SENSING REQUIREMENTS FOR HYDROLOGY AND WATER MANAGEMENT FROM THE MID-1990S, IN RELATION TO THE COLUMBUS PROGRAMME OF THE EUROPEAN SPACE AGENCY,
Bristol Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
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ESTIMATION OF THE TIME OF CONCENTRATION FOR DIVERGING SURFACES,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-10492

RAINSTORM-INDUCED EVENT SEDIMENTATION AT THE TIDEWATER FRONT OF A TEMPERATE GLACIER,
Northern Illinois Univ., De Kalb. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W88-10793

DOUBLED CO2 CLIMATE AND THE SENSITIVITY OF THE MODELED HYDROLOGIC CYCLE,
National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies.
D. Rind.
Journal of Geophysical Research JGRDE3, Vol. 93, No. D5, p 5385-5412, May 20, 1988. 13 fig, 5 tab, 25 ref, append.

Descriptors: *Hydrologic cycle, *Carbon dioxide, *Air pollution effects, *Climatology, *Available water, *Precipitation, Water temperature, Marine climates, Hydrologic models, Model studies.

Four doubled CO2 experiments with the GISS general circulation model were compared to investigate the consistency of changes in water availability over the U.S. The experiments compared the influence of model sensitivity, model resolution, and the sea surface temperature gradient. The results show that the general mid-latitude drying overland is dependent upon the degree of mid-latitude eddy energy decrease, and thus the degree of high-latitude temperature change amplification. There is a general tendency in the experiments for the northern and western U.S. to become wetter, while the southern and eastern portions dry. However, there was much variability from run to run, with different regions showing different degrees of sensitivity to the parameters tested. The results for the western U.S. depend most on model resolution: those for the central U.S. on the sea surface temperature gradient and the degree of mid-latitude ocean warming; and those for the eastern U.S. on model sensitivity. The changes in particular seasons depend on changes in other seasons, and will therefore be sensitive to the realism of the ground hydrology parameters. (Author's abstract)
W88-10908

REDUCTION OF THE SPINUP TIME FOR EVAPORATION AND PRECIPITATION IN A SPECTRAL MODEL,
Florida State Univ., Tallahassee. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W88-10911

LINKED STREAM-AQUIFER SYSTEM MODEL,
Dames and Moore, Golden, CO.
A. Prakash, and B. A. Jafari.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1454-1463, 5 fig, 5 ref.

Descriptors: *Surface-groundwater relations, *Rainfall-runoff relationships, *Hydrologic models, *Streams, *Model studies, Groundwater management, Mathematical models, LISAS model, River basin management, Hydrographs, Runoff, Water management, Rivers, wells, Streamflow, Catchment areas, Base flow.

A linked stream-aquifer system model was developed to simulate daily streamflows using climatological, land-use, and hydrogeological data. A sequential flow simulation model was used to generate hydrographs of surface runoff and deep percolation. The deep percolation component was used as input to an analytical groundwater flow model which generates and routes the hydrographs of baseflows for the stream. The two hydrographs were combined to develop virgin streamflow hydrographs at the points of interest. In an illustration of the model, the daily surface flow hydrograph was generated for a 300 sq mi sub-watershed using 6-hour precipitation and temperature and daily evapotranspiration data. (See also W88-10912) (Cassar-PTT)
W88-10985

EFFECT OF RAINSTORM EVENTS ON SPRING WATER CHEMISTRY IN LIMESTONE TERRANE,
Arkansas Univ., Fayetteville. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W88-11186

CHESAPEAKE BAY MARINE ENVIRONMENTAL ASSESSMENT: MARCH 1986 - AUGUST 1986,
Maryland Univ. Eastern Shore, Princess Anne. Coastal Ecology Research Lab.
For primary bibliographic entry see Field 2H.
W88-11261

HYDROLOGICAL DATA UNITED KINGDOM: THE 1984 DROUGHT,
Institute of Hydrology, Wallingford (England).
T. Marsh, and M. Lees.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-227443. Price codes: E06 in paper copy, E06 in microfiche. (1985). 82 p, 50 fig, 24 tab, 28 ref, 6 append.

Descriptors: *Drought, *United Kingdom, *Hydrology, *Water supply, Hydrologic cycle, Rainfall, Evaporation, Runoff, Water storage, Aquifers, Reservoirs, Water deficit, Spatial distribution.

The United Kingdom drought of 1984 is documented within a water resources framework. The development, duration and severity of the drought are examined with particular reference to regional variations in intensity. Assessments are made of the likely frequency of occurrence of the drought and its magnitude is considered both in the perspective provided by historical records of rainfall and runoff, and in the context of the recent somewhat erratic climatic behavior. A specific comparison is made with the great drought of 1975/76. The structure of the report follows the hydrological cycle with chapters devoted to rainfall, evaporation, runoff and water storage in surface reservoirs and in aquifers. (Lantz-PTT)
W88-11271

HYSTERETIC BEHAVIOUR OF MOIST CONVECTION,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 2B.
W88-11287

2B. Precipitation

ENRICHED CONCENTRATIONS OF BROMINE, CHLORINE, AND IODINE IN URBAN RAINFALL AS DETERMINED BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS,
Illinois Univ. at Urbana-Champaign. Dept. of Nuclear Engineering.
For primary bibliographic entry see Field 5B.
W88-10136

NITRATED PHENOLS IN RAIN: ATMOSPHERIC OCCURRENCE OF PHYTOTOXIC POLLUTANTS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W88-10143

PERIODIC 18, 6-YEAR AND CYCLIC 10 TO 11 YEAR SIGNALS IN NORTHEASTERN UNITED STATES PRECIPITATION DATA,
State Univ. of New York at Stony Brook.
R. G. Currie, and D. P. O'Brien.
Journal of Climatology JOUCD2, Vol. 8, No. 3, p 255-281, May/June 1988. 12 fig, 2 tab, 109 ref, append.

Descriptors: *Northeastern United States, *Climatology, *Climatic cycles, *Tides, *Precipitation, *Rainfall, *Drought, *Prediction, *Weather patterns, Luni-solar cycle.

Evidence for a narrow band-limited signal with period near 18-6 years is found in 126 out of 136 yearly total precipitation records, and in 1531 out of 1668 monthly records in the northeastern United States. In addition, a smaller band-limited term with period 10 to 11 years is found in a little more than half of the records. The wave-forms of both signals are obtained and discussed in relation to earlier published experimental results for the western U.S. From 1840 to near the end of the 19th century, rainfall minima in the wavertrain are highly correlated with tidal maxima of the 18.6-year luni-solar tide, the twelfth largest tidal constituent in Newton's theory; the wavertrain then switched phase by 180 degree and for most of the 20th century rainfall maxima are correlated with tidal maxima at 1917.5, 1936.1, 1954.7, and 1973.3. This bistable phenomenon of atmospheric science was discovered by Currie in a study of tree-rings from the Patagonian Andes, and O'Brien and Currie recently, have suggested a dynamical explanation in terms of mathematical physics. In terms of yearly rainfall, the mean percentage amplitude modulation of hte wave was near + or - 6% until 1940 after which it began to increase rapidly, reaching + or - 10% in the 1960s and 1970s. These results provide a rational explanation for the severe water shortage crisis that occurred at tidal minimum 1964.0 and reoccurred 19 years later. (Miller-PTT)
W88-10155

ONSET OF THE SOUTHWEST MONSOON OVER KERALA: 1901-1980,
Indian Inst. of Tropical Meteorology, Poona.
R. Ananthakrishnan, and M. K. Soman.
Journal of Climatology JOUCD2, Vol. 8, No. 3, p 283-296, May/June 1988. 8 fig, 5 tab, 7 ref.

Descriptors: *Monsoons, *Rainfall, *Climatic data, *Thunderstorms, *Meteorology, *India, Kerala, Statistics, Statistical analysis.

The date of the southwest monsoon over Kerala, India is a crucial date in the meteorological calendar of India as it marks the beginning of the rainy season for the country. Using daily mean rainfall from dense rain gage networks, onset dates for the southwest monsoon over north and south Kerala have been derived for the years 1901 to 1980. These dates were compared with the onset dates from records of the India Meteorological Department. Statistics of the onset dates are presented. The mean onset date for south Kerala is found to be 30 May and 1 June for north Kerala with a standard deviation of 9 days for each. Examination of rainfall series, constructed by averaging the rainfall at individual stations, revealed alternating patterns of spells of light and heavy rain amounts of varying durations. The prevailing notion that rainfall from pre-monsoon thunderstorms progressively increases and merges with the monsoon rainfall is shown to be invalid. (Miller-PTT)
W88-10156

STORM RAINFALL ON THE NJEMPS FLATS, BARINGO DISTRICT, KENYA,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
K. M. Rowntree.
Journal of Climatology JOUCD2, Vol. 8, No. 3, p 297-309, May/June 1988. 6 fig, 6 tab, 15 ref.

Descriptors: *Meteorology, *Kenya, *Storms, *Rainfall distribution, Rainfall intensity, Seasonal variation, Depth-area-duration analysis, Statistical analysis, Erosion potential, Rainfall harvesting.

Annual, seasonal and storm rainfall characteristics are analyzed for the Njemps Flats, a semi-arid area near Lake Baringo in the Kenya Rift Valley. Storm rainfall is analyzed in terms of intensity, timing, duration and total storm depth. Storms characteristically occur in the early evening, with one storm of around 2 hours making up the daily rainfall totals. High intensity rainfall seldom persists longer than 30 minutes. The maximum 30 minute intensity recorded was 80 mm/h while the maximum 60 minute intensity was 75 mm/h. An analysis of annual and monthly recurrence intervals of storm depth indicate that for a 1 in 10 year recurrence interval, the heaviest rainfall takes place in the months of June, July and April; for a 1 in 2 year recurrence interval, the months with the heaviest storms become August, July and April. The pattern and amount of rainfall is highly variable from year to year. Erosion potential and runoff harvesting are discussed. (Author's abstract)
W88-10157

IMPACT OF A SINGLE BLACK SNOWFALL ON STREAMWATER CHEMISTRY IN THE SCOTTISH HIGHLANDS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-10161

LONG-RANGE FORECAST OF THE BREAK AND ACTIVE SUMMER MONSOONS,
Ecole Polytechnique, Palaiseau (France).
D. L. Cadet, and P. Daniel.
Tellus TELLAL, Vol. 40A, No. 2, p 133-150, March 1988. 10 fig, 3 tab, 33 ref.

Descriptors: *Monsoons, *Seasonal variation, *Meteorology, *Weather forecasting, Time series analysis, Wind, Sri Lanka, Forecasting, Sumatra, India, Prediction.

Ship observations along the well-sampled shipping route from Sri Lanka to Sumatra were processed to determine the daily fluctuations of zonal and meridional components of the wind, pressure, cloudiness, air temperature and sea surface temperature (SST) over a 23-year period from 1 January 1954 to 31 December 1976. The time series of pressure and cloudiness exhibit a well-defined 30- to 50-day oscillation. Low pressure events are associated with above normal cloudiness and high pressure events are associated with below normal cloudiness. These correspond to the perturbations propagating northward during the summer monsoon which give rise to the low-frequency fluctuations of the monsoon activity. The strong relationship existing between these northward propagating perturbations and the activity of the monsoon over India was used to forecast the break and active periods of the summer monsoon. The results indicate that the activity of the monsoon can be predicted a month in advance with an average error of about a week for most of the stations over India. In particular, the method offers a way to forecast the onset of the summer monsoon at the 30-day range. (Miller-PTT)
W88-10170

CONTRIBUTION TO THE CLIMATOLOGY OF TROPOSPHERIC DYNAMICS OVER AMAZONIA (UMA CONTRIBUICAO A CLIMATOLOGIA DA DINAMICA DA TROPOSFERA SOBRE A AMAZONIA),
V. E. Kousky, and L. C. Molion.
Acta Amazonica AMAZA, Vol. 15, No. 3-4, p 311-320, September-December 1985. 5 fig, 18 ref.

Descriptors: *Climatology, *Troposphere, *Amazon, *Precipitation, *Rainfall, Seasonal variation, Spatial distribution, Amazon River, South America.

The tropospheric circulation pattern and its relation to rainfall in the Amazonas basin are discussed. The general pattern of precipitation, during the summer, is closely linked to the position of an upper tropospheric high pressure system, which dominates the circulation over South America and whose center generally forms over Bolivia. This system weakens and moves northward during fall and winter while southern and eastern portions of the Amazonas basin experience a dry season. Variability in the rainfall pattern may be due partially to persistent convergence zones, originating from or associated with the Southern Hemisphere frontal system, which greatly organizes convection over tropical Brazil. The sea breeze circulation, which affects the northern coast of Brazil, is an important factor in organizing instability lines. At time, these propagate inland remaining active for up to 48 hours crossing the entire basin and reaching the Andes. The spatial distribution of rainfall over the basin may be linked to these instability lines. (Author's abstract)
W88-10192

FREQUENCY OF DROUGHT AND SEVERE FIRE WEATHER IN NORTH-EASTERN WISCONSIN,
Wisconsin Univ., Madison. Dept. of Forestry.
C. G. Lorimer, and W. R. Gough.
Journal of Environmental Management JEVMAW, Vol. 26, No. 3, p 203-219, April 1988. 4 fig, 3 tab, 38 ref.

Descriptors: *Wisconsin, *Climatology, *Drought, *Moisture deficiency, *Fire susceptibility, *Weather patterns, *Temperature effects, Humidity, Lightning, Weather data collection.

A daily record of drought was calculated with the Keetch-Byram drought index from temperature and rainfall data for the period 1864-1979. Historic fire records indicate that most fires greater than 120 ha in size have occurred at levels exceeding the 80th percentile of 10-day mean drought index observations. Unusually large conflagrations, such as the Peshtigo Fire of 1871, occurred at levels at or exceeding, the 95th percentile on days with $<= 40\%$ relative humidity. Days with moisture conditions conducive to the spread of large fires in slash, windfall, and pine forest fuels are common; 36% of the years had at least 15 days with suitable conditions. Weather conditions similar to those at the time of historic conflagrations are much less frequent, but years with at least 10 days of extreme burning conditions have occurred at average intervals of 18 years. A comparison of drought severity in each year suggests that 1976 had by far the most severe drought conditions in the 116-year period, and that many droughts in recent decades were as severe as those at the time of post-settlement conflagrations. Lightning fires frequency is highest during drought years, apparently because of higher ignition probability during dry periods. (Author's abstract)
W88-10198

TIME-TRENDS OF SULFATE AND NITRATE IN PRECIPITATION IN NORWAY (1972-1982),
Bergen Univ. (Norway). Geofysisk Inst.
E. Berge.
Atmospheric Environment ATENBP, Vol. 22, No. 2, p 333-338, February 1988. 4 fig, 3 tab, 14 ref.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, *Sulfates, *Nitrates, *Norway, Precipitation, Temperoral distribution.

A time-trend analysis of excess-sulfate (exc(SO4)2-) and nitrate NO3- in precipitation at three Norwegian background stations over the period 1972-1982 is shown. Parameterized corrections for transport direction, precipitation amount and seasonal cycle are applied, and a 'split-half' method is used to estimate the uncertainty of the trend analysis. Despite a large decrease (3.4%/a) in the emission rates in the U.K., no corresponding negative exc(SO4)2- trend is found from this transport direction. In air masses from remote areas, like the Atlantic and Norwegian seas, a marked negative exc(SO4)2- trend is found, in accordance with reduced emission rates in middle Europe and North America. Further, increased emission rates of nitrogen compounds are reflected in a positive NO3- trend in southern Norway. The most northerly station indicates, however, a decrease in NO3-. (Author's abstract)
W88-10239

TREND AND SEASONAL VARIATION OF PRECIPITATION CHEMISTRY DATA IN THE NETHERLANDS,
Royal Netherlands Meteorological Inst., De Bilt.
T. A. Buishand, G. T. Kempen, A. J. Frantzen, H. F. R. Reijnders, and A. J. Van Den Eshof.
Atmospheric Environment ATENBP, Vol. 22, No. 2, p 339-348, February 1988. 8 fig, 1 tab, 28 ref, 3 appen.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, Trends, Ammonium, Nitrate, Sulfate, Seasonal variation, Statisitcal models, Atmospheric water, Statistical analysis, Regression analysis.

A multiple regression model is introduced to describe temporal variations in precipitation chemistry data. The model considers the effects of the annual cycle, a linear trend and precipitation-quantity simultaneously. The paper discusses the application of the model to concentrations and deposition of hydronium (H+), ammonium, nitrate and sulfate for monthly bulk samples in The Netherlands for the period 1978-1984. Statistical conclusions about the annual cycle and the trend were hardly influenced by the choice of the dependent variable (deposition, concentration or logarithm of concentration). With the exception of H+ concentrations, a large part of the temporal variation was due to precipitation-quantity effects. Significant annual cycles were found for nitrate, ammonium and sulfate. There was statistical evidence of a downward trend for sulfate and nitrate. A complex, non-linear trend was observed for H+ that resulted in a significant autocorrelation of the residuals from the regression equation. Trend-detection was emphasized. For ammonium, nitrate and sulfate, it was possible to distinguish small systematic changes in quite short records (a mean annual change of 4-6% in a 5-year record). This was not the case for H+, because temporal variations of this component were insufficiently explained by the systematic annual cycle and precipitation-quantity. (Author's abstract)
W88-10240

ACID RAIN IN SOUTHWESTERN CHINA,
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
D. Zhao, J. Xiong, Y. Xu, and W. H. Chan.
Atmospheric Environment ATENBP, Vol. 22, No. 2, p 349-358, February 1988. 6 fig, 8 tab, 19 ref.

Descriptors: *Air pollution, *Chemistry of precipitation, *Acid rain, *Chemical analysis, *China, Hydrogen ion concentration, Aerosols, Data collections, Regional analysis.

Acid rain and acidification of the environment have been environmental issues of concern in China in recent years. Approximately 90% of the monitoring stations with a mean pH of less than 5.6 are located south of the Yangtze River. In this account, new research data have been combined with those published originally in Chinese to give an overview of the acid rain picture in SW China, a region with the most serious acid rain problem in China. Results of SW China have been presented in comparison with data in northern parts of China to not only demonstrate the spatial variability, but also to reflect the impact of NH3, airborne particles and soil types on rain acidity. Based on precipitation and aerosol chemistry measurements, the source and origin of acid rain in SW China are discussed. (Author's abstract)
W88-10241

SOIL AND WATER LOSSES IN A LOW INTENSITY RAINFALL REGION IN IRAQ,
Agriculture and Water Resources Research Centre, Baghdad (Irag).
M. H. Hussein, and A. K. Othman.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 3, p 257-267, June 1988. 4 fig, 4 tab, 23 ref.

Descriptors: *Water loss, *Erosion, *Soil erosion, *Iraq, *Rainfall-runoff relationships, *Rainfall intensity, Rill erosion, Runoff, Surface runoff, Sheet erosion, Erosion rates, Mathematical analysis.

The rainfed region of northern Iraq experiences moderate to severe water erosion. The area is characterized by low intensity rainfall, so erosion characteristics in the region may differ from those of regions with high intensity rainfall. Data from two natural runoff plots in the region were used to derive preliminary rainfall-runoff and soil erosion relationships. Runoff was found to vary linearly with rainfall. Interrill or sheet erosion was the dominant erosion type on the plots. Soil loss varied exponentially with rainfall intensity and values of the exponent obtained were within the range observed in other rainfall regions. Average soil erodibility measured on each plot varied with plot surface conditions. (Author's abstract)
W88-10400

RAINFALL PATTERNS AS BACKGROUND TO PLANT PHENOLOGY IN NORTHERN TANZANIA,
Groningen Rijksuniversiteit (Netherlands). Zoologisch Lab.
H. H. T. Prins, and P. E. Loth.
Journal of Biogeography JBIODN, Vol. 15, No. 3, p 451-463, May 1988. 6 fig, 6 tab, 37 ref.

Descriptors: *Rainfall, *Rainfall distribution, *Precipitation, Seasonal variation, Spatial distribution, Prediction, Plant growth.

The rainfall pattern in time and space within the Masai Ecosystem of northern Tanzania was studied using rainfall data of sixteen stations within the area. Annual amounts of rainfall were found to be unpredictable, and the annual deviations of the long-term mean annual rainfall were without cyclic trends for the individual stations. However, the pooled rainfall data of the different stations show that series of wet and dry years alternate. Total annual rainfall increases with altitude and the variability in rainfall decreases with altitude. It appears that rainfall in the dry season is caused by thunderstorm activity, and no relation between rainfall and altitude exists during this time of year. Rainfall in the wet season shows a very different spatial relationship, indicating the effects of the monsoon. Rainfall increases with altitude, especially during the long rains. Different seasons can be discerned and the data indicate that the amount of rain in the long rainy season is more predictable than the amount in the short rainy season. The differences are discussed briefly with regard to plant phenology patterns and grass growth. (Author's abstract)
W88-10512

GEOCHEMICAL MASS-BALANCE RELATIONSHIPS FOR SELECTED IONS IN PRECIPITATION AND STREAM WATER, CATOCTIN MOUNTAINS, MARYLAND,
Geological Survey, Towson, MD.
For primary bibliographic entry see Field 5B.
W88-10518

DETERMINATION OF ALKALINE EARTH METALS IN JAPANESE RAIN AND SNOW BY ICP EMISSION SPECTROMETRY,
Meteorological Research Inst., Yatabe (Japan).
For primary bibliographic entry see Field 2K.
W88-10543

EFFECT OF RAINWATER QUALITY ON SOIL WATER AND SOIL PROPERTIES,
Finnish Forest Research Inst., Helsinki. Dept. of Forest Genetics.
For primary bibliographic entry see Field 5C.
W88-10557

THROUGHFALL CHEMISTRY (METSIKKO-SADAMAN LAATU),
Finnish Forest Research Inst., Helsinki. Dept. of Peatland Forestry.
For primary bibliographic entry see Field 5B.
W88-10559

FORECASTING THE STORM OF 15-16 OCTOBER 1987,
Meteorological Office, Bracknell (England).
R. M. Morris, and A. J. Gadd.
Weather WTHWA2, Vol. 43, No. 3, p 70-90, March 1988. 20 fig, 1 tab, 1 ref.

Descriptors: *Weather forecasting, *Storms, *Weather data collections, Prediction, England, Winds, Atmospheric pressure.

The storm of 15-16 October 1987 demonstrated how rapidly severe weather can develop and catch people relatively unawares. Having established that given adequate observations, technology and scientific understanding such a storm is forecastable, the challenge to the Meterological Office is to work towards a standard of forecasting and of the dissemination of forecasts that will be able to deal confidently with even such unusual events as the 1987 October storm. Development and progress of this storm are illustrated by charts of barometric pressure and winds for the days preceding and including the storm. Forecasts issued by the Central Forecasting Office 3-5 days before the occurrence of the storm were probably more accurate in some respects than forecasts issued some 6-18 hours before the event. In the short term the forecasters were simply not able to predict with any confidence the precise detail of the developments during the evening of the 15th over Biscay to the extent of being able to provide more than a few hours warning of violent winds across most of southern England. Warnings of severe gales for the English Channel and adjacent coastal areas were issued some 12 hr in advance although warning of the hurricane force winds actually obtained was issued less than 3 hr in advance. Whether forecasters will be able to give more accurate and more timely advice on the occurrence of such extreme weather events in the future depends very much on the availability of good data in crucially important regions of the ocean and atmosphere. (Author's abstract)
W88-10565

GREAT STORM OF 15-16 OCTOBER 1987,
S. D. Burt, and D. A. Mansfield.
Weather WTHWA2, Vol. 43, No. 3, p 90-108, March 1988. 13 fig, 5 tab, 5 ref.

Descriptors: *Weather forecasting, *Storms, *Winds, *Weather data collections, England, Storm damage, Temperature, Atmospheric pressure.

On the night of 15/16 October 1987, a fast-moving vigorous depression caused the most severe storm damage for many generations in southern England. At least 18 people died as a direct result of the

gale, and if the winds had not been at their peak during the hours of darkness there can be little doubt that many more would have died. Hundreds of millions of pounds worth of damage resulted and millions of trees were blown down. The synoptic background to the storm (including a chronology of significant events) is reconstructed, an indication of the peak winds reached and their rarity is provided, and other exceptional meterological features of the storm are examined, in particular the rapid changes in temperature and pressure. Lessons that might be learned from the storm are discussed. The extent and severity of the storm damage is described. (Author's abstract)
W88-10566

DRIVING RAIN - CALCULATIONS AND MEASUREMENTS FOR BUILDINGS,
Meteorological Office, Bracknell (England).
M. J. Prior, and A. J. Newman.
Weather WTHWA2, Vol. 43, No. 4, p 146-155, March 1988. 8 fig, 1 tab, 15 ref.

Descriptors: *Masonry, *Structures, *Buildings, *Rainfall intensity, *Weathering, *Wind velocity, *Model studies, Driving rain index, Design critera.

In the wet and windy British climate, the product of rainfall amount and wind speed is a natural choice for an index of the exposure of buildings. Such a product, the 'driving rain index', has several applications, for example as a guide to the weathering, staining or washing of building facades, or the influence of rain on the thermal transmittance of a building's fabric, or the risk of rain penetration through building features, such as window joints and tiled roofs. However, its foremost use has been in assessing the suitability of various types of masonry with a view to avoiding rain-induced dampness on inner walls. This application intensified in the energy-conscious 1970s and 1980s, when cavity wall insulation became more commonly used. (Author's abstract)
W88-10567

PHYTOPLANKTON OF AN ENRICHED, SOFT-WATER LAKE SUBJECT TO INTERMITTENT HYDRAULIC FLUSHING (GRASMERE, ENGLISH LAKE DISTRICT),
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 5C.
W88-10672

MESOSCALE REPRESENTATIVENESS OF RAINFALL MEASUREMENTS FOR WINNIPEG,
Atmospheric Environment Service, Winnipeg (Manitoba).
R. L. Raddatz.
Atmosphere-Ocean ATOCDA, Vol. 25, No. 3, p 267-278, September 1987. 5 fig, 2 tab, 19 ref.

Descriptors: *Rainfall measurement, *Rain gages, *Winnipeg, *Canada, *Weather data collections, *Rainfall distribution, Statistics, Probability distribution, Precipitation, Rainfall, Spatial distribution, Data interpretation.

Rainfall measurements from the Atmospheric Environment Service weather observing site on Winnipeg were extrapolated to ungauged locations and in some cases used as area-averages. The spatial representatives of point rainfall measurements for Winnipeg for two accumulation periods, one day and one month, were examined. Eight to nine years of data from a mesoscale network were used to specify isotropic exponential correlation functions and typical coefficients of variation. Taken together, they suggest: (1) probable errors for amounts extrapolated over distances of from 10 to 32 km of + or - 126 to 165% for estimates of daily rainfalls and = or - 36 to 48% for estimates of monthly accumulation (2) probable errors for area-average amounts with station densities of 1/54 sq km to 1/707 sq km of 21 to 85% for estimates of daily values and 6 to 24% for estimates of monthly totals. The practice of using data from a single point observation site to approximate Winnipeg's monthly area-average rainfalls may provide estimates with tolerable errors. However, basing daily area-average rainfall estimates on data from just one observation site will likely result in large errors and this practice should be avoided. Extrapolating either daily or monthly point measurements > 10 km or more from the Atmospheric Environment Service site to ungauged points should also be avoided owing to the high probability of unacceptably large estimation errors. (Author's abstract)
W88-10778

INVESTIGATION OF THE RELATIONSHIP BETWEEN SUB-SAHARAN RAINFALL AND GLOBAL SEA SURFACE TEMPERATURES,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
F. H. M. Semazzi, V. Mehta, and Y. C. Sud.
Atmosphere-Ocean ATOCDA, Vol. 26, No. 1, p 118-138, March 1988. 10 fig, 1 tab, 33 ref. NASA Task No. 677-92-24.

Descriptors: *Temperature effects, *Rainfall index, *Droughts, *Africa, *Sea surface temperature, *Meteorology, Rainfall, Time series, Simulation, Oceans.

The relationship between sea surface temperature (SST) and rainfall index anomalies over sub-Saharan Africa for the 15-year period, 1970-84, has been examined. The monthly mean SST data were used for the global oceans between 40 degrees South and 60 degrees North. The rainfall data consist of annual mean rainfall indices for the Sahel and Sudan belts over North Africa. An Empirical Orthogonal Function (EOF) analysis of the SST data has been carried out for the Atlantic, Indian and global ocean regions. The results show that the most dominant eigenmode, EOF1, is characterized by warming over the central eastern Pacific, cooling over the eastern and mid-latitude Pacific and warming over the entire Atlantic and Indian ocean basins. The second EOF for the Atlantic Ocean SST analysis shows a dipole (north-south see-saw) pattern. The third EOF for the Atlantic SST analysis has the same sign over the Atlantic basin. Global SST EOF2 and EOF3 correspond to Atlantic SST EOF3 and EOF2, respectively. The correlation between the sub-Saharan annual rainfall index, which mainly represents the summer season rainfall from June to September, and SST EOFs shows that EOF1 has statistically significant monthly correlations for the Sahel and Sudan regions and that the warm El Nino-like phases of SST EOF1 correspond to drought conditions. This suggests that the large-scale SST anomalies may be responsible for a significant component of the observed vacillation of sub-Saharan rainfall. Some preliminary simulation results from General Circulation Models that support the above findings are also presented. (Author's abstract)
W88-10781

SOME RECENT TRENDS IN PRECIPITATION IN WESTERN CANADA AND THEIR POSSIBLE LINK TO RISING CARBON DIOXIDE,
Atmospheric Dynamics Corp., Victoria (British Columbia).
M. B. Danard, and T. S. Murty.
Atmosphere-Ocean ATOCDA, Vol. 26, No. 1, p 139-145, March 1988. 3 fig, 14 ref.

Descriptors: *Climatology, *Precipitation, *Greenhouse effect, *Carbon dioxide, *Model studies, Climatic data, Air temperature, Canada, Seasonal variation, Orography, Sea surface temperature, Pacific Ocean.

Observations of the changes in mean annual and seasonal precipitation with time in British Columbia and western Alberta between the periods 1931-60 and 1951-80 indicate that more stations show an increase than a decrease. Changes tend to be positive on the coast, negative in south-central British Columbia, positive on the west slopes of the Rockies, and negative to the east. This suggests an orographic influence and increased flow from the southwest at mountain-top. Both the surface air temperature and sea surface temperature were raised by 2 C for cyclogenesis events over the northeastern Pacific and the consequences were investigated with the aid of a limited-area, 8-level, primitive equations model. The lows are deepened by as much as 6 mb and precipitation amounts are increased up to 8 mm owing to the increased mixing ratio and the feedback of latent heat energy. The possibility that precipitation changes are associated with CO2 warming was considered. It was concluded that, although precipitation has generally increased with increasing CO2, other climate fluctuations may also be a cause. (Author's abstract)
W88-10782

MESOSCALE PRECIPITATION PATTERNS AROUND WELLINGTON, NEW ZEALAND,
Meteorological Service, Wellington (New Zealand).
M. J. Salinger, R. M. Smith, and M. Tweeddale.
New Zealand Journal of Geology and Geophysics, Vol. 29, No. 1, p 99-114, 1986. 20 fig, 2 tab, 11 ref.

Descriptors: *Weather patterns, *Precipitation, *Air circulation, *New Zealand, Fronts, Orographic precipitation, Cyclonic precipitation, Meteorological data collections, Principal component analysis.

Mesoscale precipitation patterns around Wellington, New Zealand, are examined using the method of principal component analysis. Five distinct precipitation patterns emerge that are caused by six synoptic situations. Given the great variability in synoptic patterns that can occur in the New Zealand region, and the complexity of the terrain around Wellington, the similarity of synoptic analogues for each precipitation pattern is good. The results demonstrate the effects of orographic interaction on the amount and distribution of precipitation by synoptic-scale airflow in the Wellington region. (Author's abstract)
W88-10847

INTERANNUAL VARIATIONS IN NEW ZEALAND TEMPERATURE AND PRECIPITATION PATTERNS,
Meteorological Service, Wellington (New Zealand).
J. W. Kidson, and N. D. Gordon.
New Zealand Journal of Geology and Geophysics, Vol. 29, No. 3, p 363-375, 1986. 4 fig, 7 tab, 19 ref.

Descriptors: *Temperature, *Seasonal variation, *Precipitation, *New Zealand, *Weather patterns, Meteorological data collections, Air circulation, Weather forecasting, Climatic data, Climates, Prediction, Regression analysis.

Fluctuations of temperature and precipitation on a 1-3 month time scale are examined for the 21 New Zealand districts defined by Maunder. Variations in their monthly means are analyzed into empirical orthogonal functions, and much of the variance can be accounted for by relatively few components. The relation between monthly or seasonal temperature and precipitation departures and contemporary variations in sea-level flow patterns described by the indices of Kisdon and Barnes is generally quite good. Temperature variations show significant relationships with the surface flow patterns during winter and spring. Seasonal forecasts from regression equations with prior values of the mean sea level circulation indices, the Southern Oscillation Index, and the predictand itself as predictors do not appear to be possible. Precipitation predictions can be made more frequently than for temperatures but the reductions in variance obtained are probably too small to have practical value. (Author's abstract)
W88-10848

PROSPECTS FOR RAINFALL MODIFICATION IN THE EASTERN SOUTH ISLAND, NEW ZEALAND,
Meteorological Service, Wellington (New Zealand).
For primary bibliographic entry see Field 3B.
W88-10849

RELATION OF LONG- AND SHORT-TERM ATMOSPHERIC SULFUR CONCENTRATIONS TO SULFATE DEPOSITION IN NEW YORK STATE,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-10871

DECREASING TREND IN THE RAINFALL OF KERALA,
Indian Inst. of Tropical Meteorology, Poona.
M. K. Soman, K. Krishna Kumar, and N. Singh.
Current Science CUSCAM, Vol. 57, No. 1, p 7-12, January 1988. 7 fig, 5 ref.

Descriptors: *Rainfall, *Long-term trends, *Kerala, *Monsoons, *Meterological data collections, *Precipitation, Rain, Quantitative analysis, Statistical analysis, Seasonal variations, Time series analysis, India.

The rainfall time series of 75 rain recording stations over Kerala for the 80-year period 1901-1980 have been statistically examined for long-term trends. Application of Mann-Kendall rank test to the time series of annual and seasonal totals as well as extreme rainfall of 1-10 day durations (i.e., 10 different time series for each station) revealed a significant decreasing trend in the rainfall over the eastern highlands and adjacent areas to the west. This finding is supported by the fact that the mean rainfall for the second half of the period is 10 to 20% lower than for the first half over the same area. (Author's abstract)
W88-10872

DOUBLED CO2 CLIMATE AND THE SENSITIVITY OF THE MODELED HYDROLOGIC CYCLE,
National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies.
For primary bibliographic entry see Field 2A.
W88-10908

PREDICTION OF ALL-INDIA SUMMER MONSOON RAINFALL WITH REGIONAL AND LARGE-SCALE PARAMETERS,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
B. Parthasarathy, H. F. Diaz, and J. K. Eischeid.
Journal of Geophysical Research JGRDE3, Vol. 93, No. D5, p 5341-5350, May 20, 1988. 6 fig, 4 tab, 20 ref.

Descriptors: *Monsoons, *Rainfall, *Rainstorms, *Weather forecasting, Weather data collections, Statistical models, Regression analysis, India.

Using multiple regression, several statistical models were developed to predict India monsoon rainfall from conditions antecedent to the start of the monsoon season. The predictors were selected in a stepwise fashion from a set of 11 predictors. These were in turn chosen from a larger pool of 31 potential predictors on the basis of the strength of their correlation with all-India rainfall and on whether the predictor variable exhibited a significant difference in predictor mean values between wet and dry years over the period 1951-1980. The models account for between 70-83% of the interannual variance of all-India rainfall depending on the calibration period. The regressions were tested on sets of independent years. In these trials the amount of predictand (rainfall) variance realized varied from near 0 to near 60% depending on the period. The models with the highest skill (except one) actually included data from years prior to the calibration period. Hence, these models were really performing 'hindcasts', and as such would be useful only in a diagnostic rather than a prognostic mode. However, the sliding calibration model, where the regression coefficients are recalculated annually, did show some predictive skill. Many of the model predictors, e.g. the mean April latitude of the 500-mbar range over India, have been previously identified by others. New predictors, e.g. the preceding winter to spring sea level pressure change at Bombay, India, which was a leading predictor in all the models, could alone account for 50-60% of the predicted variance. The latitudinal position of the 500-mbar ridge axis in April along 75 E longitude was generally the second predictor to be entered. The regression model based on the earliest development sample (1951-70), however, had the Southern Oscillation Index of Tahiti-Darwin winter-to-spring sea level pressure tendency as its number two predictor. (Author's abstract)
W88-10909

STUDY OF LOW-LEVEL JET AND EXTREMELY HEAVY RAINFALL OVER NORTHERN TAIWAN IN THE MEI-YU SEASON,
National Taiwan Univ., Taipei. Dept. of Atmospheric Sciences.
G. T.-J. Chen, and C.-C. Yu.
Monthly Weather Review MRWEAB, Vol. 116, No. 4, p 884-891, April 1988. 7 fig, 1 tab, 29 ref. National Science Council of the Republic of China Contract NSC77-0202-M002-14.

Descriptors: *Climatology, *Weather patterns, *Rainfall, *Rainstorms, Low-level jet, Wind velocity, Taiwan.

Extremely heavy rainfall (at least 100 mm/d) is one of the most disastrous weather phenomena in the early-summer rainy season of East Asia. This season is called the Mei-Yu season in Taiwan. Thirty-five cases of this rainfall event over northern Taiwan in May-June 1964-84 were selected to study the relationship between the low-level jet (LLJ) and extremely heavy rainfall. As in Japan and China, extremely heavy rainfall was closely associated with a LLJ. For example, there was an 84% likelihood that a LLJ of at least 12.5 m/s would be present at 700 mb 12 h before the start of the rainfall event. Conversely, when a LLJ was present over Taiwan in 1980-84, there was a 91% likelihood that such a rainfall event was in progress or would begin the next day. Results provide evidence that the LLJ plays an important role in the development of this rainfall event. It appears that cumulus convection in the area of rainfall homogenizes the vertical wind profile so as to dissipate the LLJ or displace it to the immediate south, where its frequency is found to increase during and after the event. This sequence of events provides observational support to the theoretical and numerical studies which show that the LLJ may form to the south of heavy rainfall as a part of the secondary circulation driven by convective latent heating. (Author's abstract)
W88-10910

REDUCTION OF THE SPINUP TIME FOR EVAPORATION AND PRECIPITATION IN A SPECTRAL MODEL,
Florida State Univ., Tallahassee. Dept. of Meteorology.
T. N. Krishnamurti, H. S. Bedi, W. Heckley, and K. Ingles.
Monthly Weather Review MRWEAB, Vol. 116, No. 4, p 907-920, April 1988. 11 fig, 1 tab, 24 ref. National Science Foundation Grant ATM 83-04809 and National Oceanic and Atmospheric Administration Grant 82AA-D-00004.

Descriptors: *Weather forecasting, *Evaporation, *Precipitation, *Rainfall, *Mathematical models, Hydrologic models, Weather data collections.

A dynamic relaxation technique was examined to update a spectral model. The technique consists of constraining selected time dependent model variables towards their predetermined space-time estimates, while the remaining variables evolve unconstrained. The scheme involves gradual assimilation of data and thus is essentially free from data insertion shocks generally associated with data assimilation schemes. The scheme can also be used to update the model variables consistent with the observed estimates of diabatic forcings. The spatial formulation is particularly suited to relax the current estimates of model variables towards their observed estimates scale-by-scale. The scheme was applied to initialize model variables by relaxing vorticity, divergence and total mass (surface pressure) fields through one to three observation periods using an 11-layer model with T-42 spectral resolution. In addition, the moisture field and diabatic heating rates were relaxed consistent with the observed estimates of precipitation rate. The explicit two-day Newtonian relaxation of the streamfunction, velocity potential (consistent with rainfall estimates) and the surface pressure and an implicit treatment of the humidity results in a realistic initialization. Tropical rainfall, humidity analysis and the divergence field show considerable consistency and improvement. The study addresses the model initialization by this scheme and its impact on medium range forecasts using FGGE IIIb data. The reduction of the spinup time is accomplished by this procedure at the initial time. Globally averaged evaporation and precipitation exhibit an equilibrium by this procedure. A major result of this study is the ability to initialize an observed rainfall field from the use of a reverse Kuo algorithm, the Newtonian relaxation nd the overall physical initialization within this model. (Author's abstract)
W88-10911

QUALITY ASSURANCE IN ACID PRECIPITATION MEASUREMENTS,
Martin Marietta Environmental Systems, Columbia, MD.
For primary bibliographic entry see Field 7C.
W88-11174

HYDROLOGICAL DATA UNITED KINGDOM: THE 1984 DROUGHT,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W88-11271

HYSTERETIC BEHAVIOUR OF MOIST CONVECTION,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
X.-Y. Huang.
Available from the National Technical Information Service, Springfield, VA. 22161, as as N87-27354. Price codes: A03 in paper copy, A01 in microfiche. Stockholm University Report No. DM-49, February 1987. 42 p, 15 fig, 15 ref.

Descriptors: *Convection, *Moisture, *Meteorology, *Hysteresis, *Model studies, Hydrologic models, Heating, Mathematical studies, Diurnal distribution, Mathematical models.

A study of two-dimensional moist convection has been performed with a Bousinesq approximated model, where the effect of moisture is only taken into account as a flow dependent heating. In an earlier study with a highly truncated low-order model, the hysteretic behavior was found as a robust property of moist convection within an atmospherically realistic range of parameter values. The physical mechanism behind the hysteretic behavior is a positive feedback between the condensational heating and convection. In order to confirm the existence of the hysteretic behavior of moist convection in the presence of many horizontal motion scales, a high resolution model is investigated in the present study. A large number of wave components are studied. By numerically integrating the high resolution model with a slowly varying static stability, hysteretic behavior is observed as a quasi-equilibrium feature of the model. By varying the dissipation time scale and the height of the lifting condensation level, hysteretic behavior is also found to be significant with a weak dissipation and a low lifting condensation level. Furthermore, some transient characteristics of the model have also been investigated, where the diurnal cycle is simulated by a time varying static stability. The sudden transition from a state of rest to a state of convection disappears if the dissipation is too weak. (Author's abstract)
W88-11287

2C. Snow, Ice, and Frost

DETERMINATION OF THE SPRING RUNOFF FOR A BASIN WITH ABUNDANT LAKES USING A STEPWISE LINEAR STORAGE MODEL,
Helsinki Univ. (Finland). Dept. of Geophysics.

For primary bibliographic entry see Field 2E.
W88-10118

SEASONAL WATER BALANCE COMPONENTS IN HYDROLOGICAL REGIONALIZATION,
Finnish Meteorological Inst., Helsinki.
For primary bibliographic entry see Field 2E.
W88-10119

IMPACT OF A SINGLE BLACK SNOWFALL ON STREAMWATER CHEMISTRY IN THE SCOTTISH HIGHLANDS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-10161

USE OF VERTICAL SNOW SAMPLING AS AN INDICATOR OF SOME EMISSIONS FROM POINT SOURCES,
Insinoori- ja Limnologitoimisto Oy Vesitekniikka A.B., Salpakangas (Finland).
For primary bibliographic entry see Field 5A.
W88-10296

SNOW COVER AND MAXIMUM LEACHATE DISCHARGE OF A SANITARY LANDFILL,
Insinoori- ja Limnologitoimisto Oy Vesitekniikka A.B., Salpakangas (Finland).
For primary bibliographic entry see Field 5B.
W88-10304

CHARACTERISTICS OF THE ICE AND THERMAL REGIMES OF HYDROELECTRIC STATIONS AND PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8B.
W88-10430

RAINSTORM-INDUCED EVENT SEDIMENTATION AT THE TIDEWATER FRONT OF A TEMPERATE GLACIER,
Northern Illinois Univ., De Kalb. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W88-10793

2D. Evaporation and Transpiration

EFFECT OF DEFORESTATION ON THE WATER CYCLE IN THE AMAZON BASIN: AN ATTEMPT REFORMULATE THE PROBLEM,
Weizmann Inst. of Science, Rehovoth (Israel).
For primary bibliographic entry see Field 4C.
W88-10191

EVALUATION OF EVAPOTRANSPIRATION IN TROPICAL CENTRAL AFRICA,
Department of Water Affairs, Maseru (Lesotho).
T. C. Sharma.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 1, p 31-40, February 1988. 3 fig, 3 tab, 11 ref.

Descriptors: *Africa, *Evapotranspiration, *Catchment areas, *Drainage systems, *Model studies, *Hydrologic budget, Hydrology, Geohydrology, Weather data collections, Meteorological data collection, Wetlands, Lukanga Swamps, Watersheds, Swamps.

The evapotranspiration and evaporation components of the water budget for several drainage basins and a swamp in the central African tropics were evaluated by the Penman, Thornthwaite and Morton methods and by a water balance method. Hydrometeorological data from the Chambeshi and Kafue basins of Zambia were used for the purpose. The study revealed that on an annual basis areal evapotranspiration estimates based on the Morton method compare favorably with those derived by the water balance method. Thornthwaite potential evapotranspiration estimates also provide acceptable values of the evapotranspiration component on an annual basis. The Penman method was found to be the most reliable for evaporation from swamps (Lukanga swamps) in the central African tropics. (Author's abstract)
W88-10485

INFLUENCE OF EVAPOTRANSPIRATION AND PRECIPITATION ON LONG-TERM CHANGES IN EXCHANGEABLE BASE CATIONS IN FOREST SOIL (METSAMAAN VESITALOUDEN VAIKUTUKSESTA EMASKYLLASTY SASTEEN PITKAAIKAISIIN MUUTOKSIIN),
Helsinki Univ. (Finland).
For primary bibliographic entry see Field 5C.
W88-10558

COLDINGHAM LOCH, S.E. SCOTLAND: I. PHYSICAL AND CHEMICAL FEATURES WITH SPECIAL REFERENCE TO THE SEASONAL PATTERNS IN NUTRIENTS,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 2H.
W88-10659

HYDROLOGICAL DATA UNITED KINGDOM: THE 1984 DROUGHT,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W88-11271

2E. Streamflow and Runoff

INVENTORY OF RIVER BASIN CHARACTERISTICS IN FINNISH CONDITIONS USING SATELLITE IMAGERY,
Technical Research Center of Finland, Helsinki.
For primary bibliographic entry see Field 7B.
W88-10117

DETERMINATION OF THE SPRING RUNOFF FOR A BASIN WITH ABUNDANT LAKES USING A STEPWISE LINEAR STORAGE MODEL,
Helsinki Univ. (Finland). Dept. of Geophysics.
J. Virta.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 115-121, 1987. 3 fig, 1 tab, 10 ref.

Descriptors: *Snowmelt, *Runoff forecasting, *Storage capacity, *Lakes, *Model studies, Runoff, Prediction, Catchment basins, Lake basins.

Humid regions contain areas in which the storage capacity of lakes is a very important factor in determining the yearly distribution of runoff. The purpose of this paper is to show firstly that a stepwise linear storage model may be used for estimating spring runoff, and secondly that runoff data from small lakeless basins can be used as input in a model for large basins with several lakes. The model has two parameters that must be determined by calibration. The first is associated with the number of sub-basins draining to the lakes, and the second indicates the time delay of snow melt in the larger basin as compared with that of the small basin. The model may be used for forecasting purposes and for estimating runoff in cases in which runoff data are lacking. (Author's abstract)
W88-10118

SEASONAL WATER BALANCE COMPONENTS IN HYDROLOGICAL REGIONALIZATION,
Finnish Meteorological Inst., Helsinki.
R. Solantie.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 133-145, 1987. 6 fig, 5 tab, 14 ref.

Descriptors: *Hydrologic budget, *Groundwater, *Snow cover, *Ground ice, *Discharge, *Hydrological regime, *Finland, *Runoff, Catchment, Groundwater runoff, Seasonal storage, Water storage, Groundwater storage, Snow storage, Subsurface drainage.

This paper presents hydrological regional breakdowns in Finland, characterized by representative seasonal course of water balance components on the average in catchments with a few or no lakes. The total storage ('subsurface water storage') was divided into 'snow cover storage,' the 'ground water storage' and the rest, termed the 'upper water storage.' The 'upper water storage' was in winter divided into the 'water storage' and 'ice cap storage,' formed by upwelled ground water. Runoff was divided into discharging from the ground water storages and discharging from the other storages. (Author's abstract)
W88-10119

MICROBIAL INVESTIGATIONS IN RIVERS: VII. SEASONAL VARIATIONS OF BACTERIAL NUMBERS AND ACTIVITY IN EUTROPHIED RIVERS OF NORTHERN GERMANY,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 5C.
W88-10129

PHOTOLYSIS OF RHODAMINE-WT DYE,
Geological Survey, NSTL Station, MS.
For primary bibliographic entry see Field 7B.
W88-10144

MARINE DISPERSAL AND DEPOSITION OF YELLOW RIVER SILTS BY GRAVITY-DRIVEN UNDERFLOWS,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2J.
W88-10160

DISPERSAL OF THE AMAZON'S WATER,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W88-10163

DEPENDENCE OF THE CHEMICAL COMPOSITION OF THE WATER IN THE RIVER RUDAWA (SOUTHERN POLAND) ON ITS FLOW,
Polish Academy of Sciences, Krakow. Inst. of Botany.
For primary bibliographic entry see Field 5B.
W88-10171

ECOLOGICAL CHARACTERISTICS OF SESSILE ALGAL COMMUNITIES IN THE OLCZYSKI STREAM (TATRA MTS, POLAND) WITH SPECIAL CONSIDERATION OF LIGHT AND TEMPERATURE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2H.
W88-10172

DIATOM COMMUNITIES IN SOME STREAMS OF SOUTHERN GREENLAND,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2H.
W88-10173

SPECIES COMPOSITION OF ZOOPLANKTON IN SURFACE WATERS NEAR THE UPPER SILESIA IN THE ASPECT OF WATER QUALITY,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
R. Zurek.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 3, p 339-349, 1985. 2 fig, 2 tab, 25 ref.

Descriptors: *Poland, *Upper Silesia, *Surface water, *Water quality, *Water pollution effects, *Zooplankton, *Eutrophication, *Heavy metals, Oxygen depletion, River Mala Panew, River Stola, River Graniczna, Rivers, Reservoirs, Ponds, Water pollution, Bioindicators, Copecods, Cladocera, Rotifers.

The qualitative composition of zooplankton was investigated in four rivers, a pond, a dam reservoir and a flooded sand pit in the Upper Silesian Industrial Region (Poland). The occurrence of 26 Rotatoria taxons, 22 species of Cladocera, 11 species of Cyclopoida nd Calanoida, and 1 species of Harpacticoida was noted. The qualitative composition of zooplankton of the dam reservoir at Kozlowa Gora and in the pond in the park at Swierklaniec suggests the eutrophication of these water bodies. The very poor composition of zooplankton in the Rivers Stola and Graniczna Woda is caused by high concentrations of heavy metals and in the River Mala Panew also by oxygen depletion. (Author's abstract)
W88-10175

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS): 14. THE USE OF THE EXPERIMENTAL STREAM METHOD IN EVALUATING THE EFFECT OF AGRICULTURAL POLLUTION,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10176

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 1. RANGE AND AIMS OF THE INVESTIGATION WITH A DESCRIPTION OF THE ENVIRONMENT,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10177

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 2. CHEMICAL COMPOSITION OF THE WATER AND ATMOSPHERIC PRECIPITATION,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10178

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 3. CHEMICAL COMPOSITION OF THE WATER. HEAVY METALS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10179

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 5. BACTERIOLOGICAL CHARACTERISTICS OF THE WATERS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10181

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 6. COMMUNITIES OF PLANKTON ALGAE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10182

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 7. ZOOPLANKTON - QUANTITATIVE RELATIONS IN VARIOUS SYSTEMATIC GROUPS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10183

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 9. COMMUNITIES OF OLIGOCHAETES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10185

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 10. BOTTOM INSECTS WITH SPECIAL REGARD TO CHIRONOMIDAE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10186

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 12. SYNTHETIC OUTLINE OF INVESTIGATION RESULTS AND CONCLUSIONS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10188

ENVIRONMENTAL STRUCTURES IN THE RIVER MOUTH SYSTEMS OF THE CENTRAL ZONE OF CHILE (V REGION) (ESTRUCTURAS AMBIENTALES IN LOS SISTEMAS DE DESEMBOCADURA DE RIOS Y ESTEROS DE LA ZONA CENTRAL DE CHILE (V REGION)),
Universidad de Valparaiso (Chile). Inst. de Oceanologia.
For primary bibliographic entry see Field 2H.
W88-10200

SEASONAL VARIATION IN THE ABUNDANCE AND HETEROTROPHIC ACTIVITY OF SUSPENDED BACTERIA IN TWO LOWLAND RIVERS,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 2H.
W88-10202

SPATIAL AND TEMPORAL VARIATION IN THE MACROINVERTEBRATE FAUNA OF STREAMS OF THE NORTHERN JARRAH FOREST, WESTERN AUSTRALIA: COMMUNITY STRUCTURE,
Western Australia Univ., Nedlands. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-10204

PEAT AND PEAT WATER CHEMISTRY OF A FLOOD-PLAIN FEN IN BROADLAND, NORFOLK, U.K.,
Sheffield Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W88-10205

MICROHABITAT SELECTION BY A STREAM-DWELLING AMPHIPOD: A MULTIVARIATE ANALYSIS APPROACH,
Toronto Univ. (Ontario). Div. of Life Sciences.
For primary bibliographic entry see Field 2H.
W88-10206

STREAM HYDRAULICS AS A MAJOR DETERMINANT OF BENTHIC INVERTEBRATE ZONATION PATTERNS,
Karlsruhe Univ. (Germany, F.R.). Zoologisches Inst.
For primary bibliographic entry see Field 2H.
W88-10207

PREDICTION OF THE MACRO-INVERTEBRATE FAUNA OF UNPOLLUTED RUNNING-WATER SITES IN GREAT BRITAIN USING ENVIRONMENTAL DATA,
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 2H.
W88-10210

COLONIZATION OF RIVERS AND CANALS IN GREAT BRITAIN BY DUGESIA TIGRINA (GIRARD) (PLATYHELMINTHES: TRICLADIDA),
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W88-10211

INFLUENCE OF MICROHABITAT ON AVAILABILITY OF DRIFTING INVERTEBRATE PREY TO A NET-SPINNING CADDISFLY,
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 4C.
W88-10213

MODEL FOR FLOOD PROPAGATION ON INITIALLY DRY LAND,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
A. A. Akanbi, and N. D. Katopodes.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 689-706, July 1988. 9 fig, 22 ref, append.

Descriptors: *Flooding, *Flash floods, *Overland flow, *Model studies, *Simulation, *Arid lands, *Wave propagation, *Floods, Mathematical equations, Algorithms, Hydrologic models, Hydrodynamics.

A model is presented for the simulation of shallow water flow and, specifically, flood waves propagating on a dry bed. The governing equations are transformed to an equivalent system valid on a deforming coordinate system and are solved by a dissipative finite-element technique. A second-order difference scheme is employed for the integration in time. The implicit nonlinear equations resulting from the weak formulations are solved by the Newton-Raphson method, and the set of linear algebraic equations generated is solved by a frontal algorithm. A deforming grid generation scheme is introduced in the dissipative finite-element formulation to account for the effects of the propagating or receding wave fronts on dry land. The accuracy and stability of the model is examined by comparing the model results with observed data from an experimental field test. Results of trial runs for the simulation of overland flow are also presented. (Author's abstract)
W88-10227

ENTROPY AND 2-D VELOCITY DISTRIBUTION IN OPEN CHANNELS,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
C. L. Chiu.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 738-756, July 1988. 9 fig, 1 tab, 15 ref, appen.

Descriptors: *Flow profiles, *Channel flow, *Flow characteristics, *Entropy, *Thermodynamics, *Open channels, *Cross-sections, *Velocity distribution, Mathematical equations, Model studies, Hydrodynamics.

Equations based on the entropy concept have been derived for describing the two-dimensional velocity distribution in an open-channel cross section. The velocity equation derived is capable of describing the variation of velocity in both the vertical and transverse directions, with the maximum velocity occurring on or below the water surface. Equations for determining the location of mean

velocity have also been derived along with those, such as the entropy function, that can be used as measures of the homogeneity of velocity distribution in a channel cross section. A dimensionless parameter of the entropy function named the M number has been found useful as an index for characterizing and comparing various patterns of velocity distribution and states of open-channel flow systems. The definition and demonstrated usefulness of this parameter indicate the importance and value of the information given by the location and magnitude of maximum velocity in a cross section, and suggest the need for future experimental and analytical studies about maximum velocity. (Author's abstract)
W88-10230

RATIONALIZED ENERGY-LOSS PARAMETERS FOR CHANNELS,
Tasmania Hydro-Electric Commission, Hobart (Australia).
A. C. E. Knight.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 757-765, July 1988. 1 fig, 3 tab, 8 ref.

Descriptors: *Energy loss, *Flow pattern, *Flow characteristics, *Open channels, *Channel flow, *Model studies, *Hydrologic models, *Boundary conditions, Hydrodynamics, Friction, Cross sections.

All hydraulic computations involving flow in open channels require an evaluation of energy-loss parameters. A fundamental approach is to assess the different types of energy loss separately. Methods of doing this are described, including a new method using the concept of friction distance and dummy boundaries for computing flow through vegetation. Dummy boundaries are also useful where there is dead water or a large eddy, but care is needed in assessing form losses to account for the assumed flow pattern in the reduced cross section. The parameters used are reasonably easy to assess and are less variable with depth than Manning's n-values. The method described is less subject to limitations due to lack of measurements in a given river. This is because each parameter is based on a physical feature that can be measured or estimated. (Author's abstract)
W88-10231

EFFECT OF BED AND SIDE ROUGHNESS ON DISPERSION IN OPEN CHANNELS,
Regional Engineering Coll., Srinagar (India).
M. K. Magazine, S. K. Pathak, and P. K. Pande.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 766-782, July 1988. 9 fig, 3 tab, 18 ref, 2 appen.

Descriptors: *Hydraulic roughness, *Flow characteristics, *Flow resistance, *Channel flow, *Channel morphology, *Open channels, *Hydrodynamics, *Hydraulics, Drag, Resistance, Roughness coefficient, Model studies, Hydrologic models, Data interpretation.

Dispersion in open-channel flow is significantly affected by boundary roughness. The analysis of data generated in the present experimental program shows that the dimensionless dispersion coefficient is a function of two interacting mechanisms, namely, resistance and blockage effect due to roughness elements. The dispersion characteristics of channels with rough beds are found to be analogous to those of channels with rough sides. The proposed parameter P, which incorporates the influence of resistance and blockage effect, yields a good correlation with the available dispersion data. The empirical model developed in the present study may be used to predict dispersion coefficients in straight laboratory and field channels. (Author's abstract)
W88-10232

GENERAL TWO-POINT METHOD FOR DETERMINING VELOCITY IN OPEN CHANNEL,
Geological Survey, Madison, WI.
For primary bibliographic entry see Field 7C.
W88-10234

CADMIUM IN THE RHONE RIVER,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5B.
W88-10265

FISH COMMUNITIES OF THE UPPER DANUBE RIVER (GERMANY, AUSTRIA) PRIOR TO THE NEW RHEIN-MAIN-DONAU CONNECTION,
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W88-10284

WINTER AND SUMMER LOW FLOWS IN FINLAND,
National Board of Waters, Helsinki (Finland). Hydrological Office.
E. Kuusisto.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 181-186, 1987. 4 fig, 1 tab, 7 ref.

Descriptors: *Finland, *Runoff. *Snow, *Low flow, *Seasonal variation, Annual runoff, Lakes.

Mean minimum winter and summer flows throughout Finland were analyzed. Data from 91 basins ranging in area roughly from 100 to 10,000 sq km were used. The winter minimum was significantly explained by lake percentage and basin area. The summer minimum was also explained by mean maximum water equivalent of snow and by mean annual temperature. General characteristics of low flows and their time of occurrence are discussed and some comparisons to earlier studies of small basins are made. (Author's abstract)
W88-10303

CHEMICAL COMPOSITION OF THE WATER IN THE RIVER MALA PANEW, AND ITS TRIBUTARIES, AND OF THE GROUND WATER IN ITS BASIN IN THE UPPER SILESIAN INDUSTRIAL REGION (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10364

EFFECT OF THE GOCZALKOWICE DAM RESERVOIR ON THE HYDROCHEMICAL CONDITIONS OF THE RIVER VISTULA BELOW THE DAM (SOUTHERN POLAND),
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 5B.
W88-10366

INDICES OF BACTERIOLOGICAL AND CHEMICAL QUALITY OF WATERS IN THE UPPER SILESIAN INDUSTRIAL REGION (SOUTHERN POLAND) AFFECTED BY ATMOSPHERIC POLLUTION AND INDUSTRIAL WASTES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10367

MICROBIOLOGICAL CHARACTERISTICS OF THE RIVER DUNAJEC WATERS IN THE SECTOR BETWEEN NOWY TARG AND NOWY SACZ (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10368

ALGAE AND SOME BACTERIA IN THE PLANKTON OF THE RIVER MALA PANEW AND ITS TRIBUTARIES POLLUTED WITH INDUSTRIAL DISCHARGED WATERS (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10369

STRUCTURE OF A DIATOM COMMUNITY IN THE SPRING SECTOR OF A STREAM WITH LOW PH (BIALA WISELKA, SILESIAN BESKID, POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. Kwandrans.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 139-148, 1986. 7 fig, 27 ref.

Descriptors: *Acidity, *Steams, *Acid streams, *Springs, *Stream Biota, *Species diversity, *Ecosystems, Hydrogen ion concentration, Ecology, Algae, Diatoms, Air pollution effects, Bioindicators, Water pollution effects, Indicators, Species composition, Density, Population density, Biomass, Poland.

The structure of the diatom community developing in the spring sector of a mountain stream with low pH was studied. The diatom community was characterized by the number of taxa, their abundance, coverage coefficient, and the index of their biomass. The value of the coverage coefficient was used to characterize the dominant species and the index of the diatom biomass was obtained by summing the values of the coefficient index. Species abundance and biomass index was low or average. Little species variety was observed in the community. The following species occurring in acid waters were of essential importance: Eunotia exigua, E. tenella, and E. trinacria. The effect of water acidity on cell morphology included changes in linear dimensions, the number of striae in 10 microns, and the shape of the valve. No important seasonal changes were observed in diatom community structure during the period of investigation. (Doria-PTT)
W88-10370

EFFECT OF THE GOCZALKOWICE DAM RESERVOIR ON ZOOBENTHOS OF THE RIVER VISTULA (SOUTHERN POLAND),
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 5C.
W88-10372

ACTIVITY OF BACTERIAL FLORA IN THE RIVER NIDA, IN STRETCHES DIFFERING IN GEOLOGICAL SUBSTRATUM AND SOILS NEAR THE BANKS (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Starzecka, and G. Mazurkiewicz.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 3/4, p 317-328, 1986. 3 fig, 2 tab, 34 ref.

Descriptors: *Rivers, *Nonpoint pollution sources, *Path of pollutants, *Eutrophication, *Bacteria, *Soil types, *Bioaccumulation, *Biodegradation, Aquatic bacteria, Heterotrophic bacteria, Trophic level, River Nida, Banks, Stream banks, Poland, Biomass, Accumulation, Degradation, Microbial degradation, Energy, Catchment areas, Respiration.

The production of bacterial biomass and the magnitude of its bioaccumulation and biodegradation were determined for stretches of the river differing in the kind of soil near the banks. The amount of energy used for bioaccumulation and biodegradation increased in the lower part of the catchment area of the Nida. The trophic level of the water increased with the course of the river, this being indicated by a fall in the value of Schroedinger's coefficient and a rise in the coefficient of heterotrophic activity, determined in relation to asparagine. It is concluded that the varying character of the soils in the lower and upper parts of the drainage basin might contribute to smaller or larger fluctuations in the trophic level of the water, which were evident in periods of increased surface runoff. However, the increase in nutrients in the lower part of the basin was affected by many factors in addition to runoff, such as the geological structure of the substratum, hydrological condi-

tions, and pollution, as well as the cumulative effect of material carried with the current from its upper reaches. (Author's abstract)
W88-10377

LABORATORY STUDIES IN THE EFFECT OF DIFFERENT CONDITIONS OF OXYGENATION ON THE BIOSESTON OF THE UPPER VISTULA (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10378

COMMUNITIES OF SESSILE ALGAE IN THE RIVER DUNAJEC, ABOVE AND BELOW THE DAM RESERVOIRS OF ROZNOW AND CZCHOW (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10379

BOTTOM INSECTS, CHIEFLY CHIRONOMIDAE, IN THE RIVER MALA PANEW AND ITS TRIBUTARIES POLLUTED WITH INDUSTRIAL WASTES (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10380

EVOLUTION OF THE CHEMICAL COMPOSITION OF THE GARONNE RIVER WATER DURING THE PERIOD 1971-1984,
Toulouse-3 Univ. (France). Lab. de Mineralogie et Cristallographie.
For primary bibliographic entry see Field 5B.
W88-10399

ANALYTICAL SOLUTION OF CHANNEL FLOW MODEL WITH DOWNSTREAM CONTROL,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
J. J. Napiorkowski, and J. C. I. Dooge.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 3, p 269-287, June 1988. 5 fig, 2 tab, 8 ref.

Descriptors: *Model studies, *Channel flow, *Hydraulics, *Stage-discharge relations, *Gaging, *Unsteady flow, Hydraulic models, Boundaries, Flow, Mathematical equations, Mathematic models.

The effect of the downstream boundary condition on unsteady flow in channels is explored through an analysis of the linearized St. Venant equations. The effects of downstream and upstream boundary conditions at an intermediate point in the reach are evaluated. The analytical results obtained are applicable to any shape of cross section and any type of friction law. The quantitative effects of the two boundary conditions are compared for the case of a wide rectangular channel with Chezy friction. It is anticipated that the relative effects would be similar for other shapes of channel and other friction formulae. (Author's abstract)
W88-10401

CONTRIBUTION OF SOIL MOISTURE STORAGE TO THE WATER BALANCES OF UPLAND FORESTED AND GRASSLAND CATCHMENTS,
Institute of Hydrology, Powys (Wales).
For primary bibliographic entry see Field 2A.
W88-10402

ANALYSIS OF SOME VELOCITY-AREA METHODS FOR CALCULATING OPEN CHANNEL FLOW,
Technical Univ. of Lisbon (Portugal). Inst. Superior Tecnico.
For primary bibliographic entry see Field 7B.
W88-10403

COMPARISON OF COMMUNITY STRUCTURE AMONG STREAMS WITH DIFFERENT TEMPORAL FLOW REGIMES,
Cornell Univ., Ithaca, NY. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W88-10411

RECHARGE FROM A RIVER OF LARGE WIDTH TO A SHALLOW WATER-TABLE AQUIFER,
National Inst. of Hydrology, Roorkee (India).
For primary bibliographic entry see Field 2F.
W88-10417

CHARACTERISTICS OF THE ICE AND THERMAL REGIMES OF HYDROELECTRIC STATIONS AND PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8B.
W88-10430

ROLE OF SMALL HYDROELECTRIC STATIONS IN THE RATIONAL USE OF SMALL RIVERS,
For primary bibliographic entry see Field 4A.
W88-10433

EFFECT OF DOMESTIC SEWAGE ON THE STRUCTURE OF THE MICROBENTHIC CILIATE COMMUNITIES IN THE LYNA RIVER,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Water and Wastewater Biology.
For primary bibliographic entry see Field 5C.
W88-10437

AGE CLASS DISTRIBUTION AND SIZE OF AMERICAN EEL (ANGUILLA ROSTRATA) IN THE SHETUCKET/THAMES RIVER, CONNECTICUT,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 8I.
W88-10450

COMMUNITY METABOLISM IN NATURAL AND AGRICULTURALLY DISTURBED RIFFLE SECTIONS OF THE CHIPPEWA RIVER, ISABELLA COUNTY, MICHIGAN,
Central Michigan Univ., Mount Pleasant.
For primary bibliographic entry see Field 5C.
W88-10451

RELATION BETWEEN HUMAN PRESENCE AND OCCURRENCE OF GIARDIA CYSTS IN STREAMS IN THE SIERRA NEVADA, CALIFORNIA,
Geological Survey, Sacramento, CA.
For primary bibliographic entry see Field 5B.
W88-10453

BENTHOS IN BEAR CREEK, MISSISSIPPI: EFFECTS OF HABITAT VARIATION AND AGRICULTURAL SEDIMENTS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 5C.
W88-10456

RESISTANCE OF THE PROSOBRANCH MOLLUSK, POTAMOPYRGUS JENKINSI (E.A. SMITH 1889) TO INCREASING TEMPERATURES: AN EXPERIMENTAL STUDY (RESISTANCE DU MOLLUSQUE PROSOBRANCHE POTAMOPYRGUS JENKINSI (E.A. SMITH, 1889) AUX TEMPERATURES CROISSANTES: ETUDE EXPERIMENTALE),
Limoges Univ. (France).
For primary bibliographic entry see Field 2H.
W88-10462

OLIGOCHAETES OF A RIVER IN THE SOUTH ALPS, THE BUECH (LES OLIGOCHETES D'UNE RIVIERE DES ALPES DU SUD, LE BUECH),
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 5C.
W88-10465

FAUNISTIC STUDY OF CHIRONOMIDS (DIPTERA) OF THE UPPER NESTE D'AURE (CENTRAL PYRENEES): THE IMPACT OF HYDROELECTRIC SCHEMES (ETUDE FAUNISTIQUE DES CHIRONOMIDES (DIPTERA) DE LA HAUTE NESTE D'AURE (PYRENEES CENTRALES): IMPACT DES AMENAGEMENTS HYDROELECTRIQUES),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 6G.
W88-10466

NUMERICAL SIMULATION OF PHYTOPLANKTON DYNAMICS IN A SUCCESSION OF WATER BODIES WITH SHORT RETENTION TIME ON THE RIVER LOT (SIMULATION NUMERIQUE DE LA DYNAMIQUE DU PHYTOPLANCTON DANS UNE SUCCESSION DE RESERVOIRS A FAIBLE TEMPS DE RETENTION SUR LA RIVIERE LOT),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W88-10470

POPULATIONS OF CLADOCERA (CRUSTACEA), AS DESCRIBED BY THE HYDROLOGICAL FUNCTIONING OF STAGNANT WATERWAYS (LES PEUPLEMENTS DE CLADOCERES (CRUSTACES), DESCRIPTEURS DU FONCTIONNEMENT HYDROLOGIQUE DES BRAS-MORTS FLUVIAUX),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
For primary bibliographic entry see Field 2H.
W88-10471

MICRODISTRIBUTION OF EPILITHIC ALGAE ON THE STONES OF A CORSICAN STREAM, THE RIZZANESE (MICROREPARTITION DES ALGUES EPILITHIQUES SUR LES CAILLOUX D'UN TORRENT CORSE, LE RIZZANESE),
Aix-Marseille-3 Univ. (France). Lab. de Biologie Animale et Ecologie.
For primary bibliographic entry see Field 2H.
W88-10472

PHYSICAL AND BIOLOGICAL STABILITY OF INTERSTITIAL HABITATS. CASE OF TWO STATIONS OF THE UPPER RHONE (STABILITE PHYSIQUE ET BIOLOGIQUE DES MILIEUX INTERSTITIELS. CAS DE DEUX STATIONS DU HAUT RHONE),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
For primary bibliographic entry see Field 2H.
W88-10473

IMPACT OF A SPATE ON THE COMMUNITY OF MACROINVERTEBRATES OF THE RIVER DURANCE. THE ROLE OF THE DRIFT IN THE RECONSTITUTION OF THE FAUNA IN THE MAIN CHANNEL (IMPACT D'UNE CRUE SUR LA COMMUNAUTE D'INVERTEBRES DE LA MOYENNE DURANCE. ROLE DE LA DERIVE DANS LA RECONSTITUTION DU PEUPLEMENT DU CHENAL PRINCIPAL),
Aix-Marseille-3 Univ. (France). Lab. de Biologie Animale et Ecologie.
For primary bibliographic entry see Field 2H.
W88-10475

MODELING OF PHYTOPLANKTON DEVELOPMENT IN A EUTROPHIC CHANNELIZED RIVER: LE LOT (FRANCE) (MODELISATION DU DEVELOPPMEMENT DU PHYTOPLANCTON DANS UNE RIVIERE CANALISEE EUTROPHE: LE LOT (FRANCE)),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W88-10476

SIMULIIDAE (DIPTERA: NEMATOCERA) OF THE NESTE D'AURE (CENTRAL PYRENEES) I. THE IMPACT OF HYDROELECTRIC SCHEMES IN THE UPPER VALLEY (LES SIMULIIDAE (DIPTERA: NEMATOCERA) DE LA NESTE D'AURE (PYRENEES CENTRALES). I. IMPACT DES AMENAGEMENTS HYRODELECTRIQUE DANS LA HAUTE),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 6G.
W88-10478

AQUATIC MICROHABITATS OF THE BANKS OF A LARGE WATER COURSE: THE FAUNISTIC APPROACH (LES MICROHABITATS AQUATIQUES DES RIVES D'UN GRAND COURS D'EAU: APPROCHE FAUNISTIQUE),
Lyon-1 Univ., Villeurbanne (France). Section of Freshwater Ecology.
For primary bibliographic entry see Field 2H.
W88-10481

ROLE OF CO2 IN LONG TERM STREAM ACIDIFICATION PROCESSES: A MODELING VIEWPOINT,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2H.
W88-10489

ESTIMATION OF THE TIME OF CONCENTRATION FOR DIVERGING SURFACES,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
N. Agiralioglu.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 2, p 173-179, April 1988. 3 fig, 10 ref.

Descriptors: *Divergence, *Rainfall, *Kinematic wave theory, *Rainfall-runoff relationships, *Runoff, *Overland flow, *Watersheds, *Model studies, Slope, Roughness, Physical properties, Mathematical studies, Statistical methods, Equations.

A solution is obtained for estimating the time of concentration for a diverging watershed. A comparison of concentration times for diverging and plane surfaces is made to examine the influence of the degree of divergence for a diverging watershed on the time of concentration. Assuming that the physical characteristics such as watershed length, slope, roughness and rainfall excess are the same, an expression of the ratio of the time of concentration for a diverging surface to that for a plane surface is derived. The expression is solved numerically, and evaluated graphically. The results can be used easily for practical purposes. (Author's abstract)
W88-10492

APPLICATION OF THE LINEAR PERTURBATION MODEL (LPM) TO FLOOD ROUTING ON THE MEKONG RIVER,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
R. K. Kachroo, G. C. Liang, and K. M. O'Connor.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 2, p 193-214, April 1988. 6 fig, 6 tab, 11 ref, append.

Descriptors: *Mekong River, *Flood forecasting, *Model studies, *Linear perturbation model, *Routing, *Flood routing, *Statistical methods, Mathematical studies, Hydrology, Geohydrology, Asia, Calibrations, Rivers.

Using eight years for calibration out of a total of 19 years of daily discharges at the five stations, Luang Praband, Vientiane, Thakhek, Pakse and Kratie (located about 250 km apart on the Mekong River), the LPM model was applied for flood routing on four reaches, namely, from each upstream station to the downstream station of Kratie. Both nonparametric (unconstrained) and parametric (transfer function) forms of the model are calibrated by least squares, initially in design mode (without updating), and the resulting model variances are obtained, using the last 11 years of data for verification (i.e. model validation). The transfer function form is also applied in real-time forecasting mode for various lead times (up to four days), using simple autoregressive models calibrated for the individual upper reaches, to forecast the inflows over the various lead times, together with the measured outflows up to and including the time origin of the forecast. (Author's abstract)
W88-10494

SITE-SPECIFIC BARIUM TOXICITY TO COMMON DUCKWEED, LEMNA MINOR,
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 5C.
W88-10503

PLANKTON, CHLOROPHYLL CHARACTERISTICS AND FISHERY POTENTIAL OF SURFACE COAL MINE LAKES IN WESTERN PENNSYLVANIA,
Grove City Coll., Pa. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-10514

BENTHIC MACROINVERTEBRATES AS INDEXES OF WATER QUALITY IN THE UPPER CUYAHOGA RIVER,
Akron Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-10515

FISHES AND AQUATIC INSECTS OF NIPPERSINK CREEK, MCHENRY COUNTY, ILLINOIS,
Memphis State Univ., TN. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-10552

SURVEY OF THE FISHES AND MACROINVERTEBRATES OF SOME SMALL STREAMS IN COOK, LAKE, AND DUPAGE COUNTIES, ILLINOIS,
Memphis State Univ., TN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10553

EFFECTS OF RIVER FLOODS ON SEDIMENT DISPERSAL IN SMALL ESTUARIES: A CASE STUDY FROM EAST LONDON,
Port Elizabeth Univ. (South Africa). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W88-10564

SEASONAL CHANGE OF STREAMWATER CHEMISTRY IN TSUKUBA EXPERIMENTAL FORESTED LAND,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
For primary bibliographic entry see Field 2K.
W88-10571

ESTIMATION OF WATER QUALITY AND NUTRIENT LOADS IN THE HII RIVER BY SEMI-DAILY SAMPLING,
Shimane Prefectural Inst. of Public Health and Environmental Science, Matsue (Japan).
Y. Ishitobi, M. Kawatsu, H. Kamiya, K. Hayashi, and H. Esumi.
Japanese Journal of Limnology RIZAA, Vol. 49. No. 1, p 11-17, January 1988. 4 fig, 4 tab, 16 ref.

Descriptors: *Water quality, *Nutrients, *Limnology, *Statistical methods, *Water quality, Phosphorus, Flooding, Rivers, Seasonal variation, Japan, Hii river.

Semi-daily sampling was carried out from July 1983 to June 1984 to evaluate nutrient loads in the Hii River. The variation of concentration was synchronized with the variation of flow for all examined substances. The strong increase in concentration of suspended substance (SS), ignition loss (IL) and total phosphorus (TP) was found at the flush stage of flooding. Statistical analysis on the variation of concentration was conducted for all examined substances except for ammonium-nitrogen (NH4-N). Using the concentration-flow data collected during the first half interval, log load-log flow relationships were obtained. All relationships were significant and linearity as to total nitrogen (TN) and TP was ensured. There was little difference between the predicted and observed value for TN and TP load during the last half period. Annual load from July 1983 to June 1984 was estimated to be 857 and 95.6 t for TN and TP, respectively. (Author's abstract)
W88-10572

BIODEGRADATION AND ADSORPTION OF LINEAR ALKYLBENZENE SULFONATES (LAS) IN THE RIVER ENVIRONMENT - A CASE STUDY ON RIVER AKASHI OF HYOGO PREF., (IN JAPANESE),
Hyogo Prefecture Environmental Science Inst., Kobe (Japan).
For primary bibliographic entry see Field 5B.
W88-10574

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): I. GEOGRAPHICAL DESCRIPTION, HYDROGRAPHIC COMPONENTS AND MAN'S IMPACT,
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
For primary bibliographic entry see Field 2H.
W88-10590

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): II. HYDROLOGICAL BUDGET OF LAKES IN 1978 AND 1979,
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
For primary bibliographic entry see Field 2H.
W88-10591

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VIII. ZOOSYRTHON IN THE TRIBUTARIES AND OUTLET OF LAKE JORZEC,
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
For primary bibliographic entry see Field 2H.
W88-10597

SESTON OF THE WARSAW REACH OF THE VISTULA RIVER IN 1982 AND 1983: I. CHLOROPHYLL AND ENVIRONMENTAL CONDITIONS,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W88-10601

SESTON OF THE WARSAW REACH OF THE VISTULA RIVER IN 1982 AND 1983: II. DRY WEIGHT AND ORGANIC CARBON,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W88-10602

SESTON OF THE WARSAW REACH OF THE VISTULA RIVER IN 1982 AND 1983: III. PHYTO- AND ZOOPLANKTON,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W88-10603

PHYTOSESTON OF THE VISTULA RIVER BETWEEN GORA KALWARIA AND NOWY DWOR MAZOWIECKI IN 1982,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W88-10604

EFFECT OF IMPOUNDMENTS ON THE QUALITY OF WATER AND BIOCOENOSIS IN THE LOWLAND STREAMS RAWKA AND SKIERNIEWKA - SUMMER ASPECT,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W88-10607

STRUCTURE OF PHYTOPLANKTON IN RIVERS AND IN LAKES OF NORTHEASTERN POLAND,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W88-10608

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: I. INTRODUCTION,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 2H.
W88-10612

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: II. CHARACTERISTICS OF THE CATCHMENT AREA,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 2H.
W88-10613

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: V. SOLAR RADIATION PENETRATING THE RESERVOIR,
Polish Academy of Sciences, Chybie. Fish Culture Experimental Station.
For primary bibliographic entry see Field 2H.
W88-10616

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: VI. BOTTOM SOILS OF THE RESERVOIR (AS OF 1953),
Akademia Rolnicza, Krakow (Poland).
For primary bibliographic entry see Field 2H.
W88-10617

AQUATIC MICROANNELIDS (OLIGOCHAETA AND APHANONEURA) OF UNDERGROUND WATERS OF SOUTHEASTERN NEW YORK,
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
D. Strayer, and E. Bannon-O'Donnell.
American Midland Naturalist AMNAAF, Vol. 119, No. 2, p 327-335, April 1988. 2 fig, 3 tab, 28 ref.

Descriptors: *Annelids, *Oligochaetes, *Aphanoheura, *Subsurface water, *Aquatic fauna, *Aquatic populations, Aquatic environment, Seasonal variations, Fertility, Population dynamics, Lakes, Streams, New York.

The authors investigated the distribution of aquatic oligochaetes and Aeolosoma in the hyporheic zone and other underground habitats in southeastern New York. Twenty-four species of oligochaetes were found, exclusive of the Enchytraeidae, which could not be identified to species. Two of the species, Rhyaocodrilus cf. subterraneus and Chaetogaster cf. krasnopolskiae, are reported for the first time from North America. Most of the oligochaetes found in underground waters are widespread in surface waters as well. Annual cycles of abundance and reproductive activity of five abundant taxa are described; these cycles are similar to those of the oligochaetes from lakes and streams. (Author's abstract)
W88-10634

SPATIAL AND TEMPORAL AVAILABILITY OF FLOODPLAIN HABITAT: LONG-TERM CHANGES AT POOL 19, MISSISSIPPI RIVER,
Illinois Natural History Survey, Havana. River Research Lab.
For primary bibliographic entry see Field 2H.
W88-10636

COLLOIDAL AND DISSOLVED ORGANIC CARBON DYNAMICS IN UNDISTURBED BOREAL FOREST CATCHMENTS: A SEASONAL STUDY OF APPARENT MOLECULAR WEIGHT SPECTRA,
University Coll. of North Wales, Bangor. School of Animal Biology.
For primary bibliographic entry see Field 2H.
W88-10653

PERIPHYTON COMMUNITIES IN A PRISTINE MOUNTAIN STREAM ABOVE AND BELOW HEAVY METAL MINING OPERATIONS,
Victoria Univ. (British Columbia). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10654

ANTARCTIC STREAM ECOSYSTEMS: PHYSIOLOGICAL ECOLOGY OF A BLUE-GREEN ALGAL EPILITHON,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
For primary bibliographic entry see Field 2H.
W88-10655

FIELD EXPERIMENTS ON THE RELATIONSHIP BETWEEN DRIFT AND BENTHIC DENSITIES OF AQUATIC INSECTS IN TROPICAL STREAMS (IVORY COAST): III. TRICHOPTERA,
Karlsruhe Univ. (Germany, F.R.). Zoologisches Inst.
For primary bibliographic entry see Field 2H.
W88-10658

ORDINATION AND CLASSIFICATION OF MACROINVERTEBRATE ASSEMBLAGES IN THE CATCHMENT OF THE RIVER WYE IN RELATION TO ENVIRONMENTAL FACTORS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 2H.
W88-10664

DISSOLVED ORGANIC CARBON, SESTON AND MACROINVERTEBRATE DRIFT IN AN ACIDIFIED AND LIMED HUMIC STREAM,
Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 5G.
W88-10666

RELATIVE IMPORTANCE OF ALGAE AND BACTERIA AS FOOD FOR DAPHNIA LONGISPINA (CLADOCERA) IN A POLYHUMIC LAKE,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
For primary bibliographic entry see Field 2H.
W88-10667

DECAY RATES OF AUTUMN AND SPRING LEAF LITTER IN A STREAM AND EFFECTS ON GROWTH OF A DETRITIVORE,
Division of Ecology (Aquatic Ecology Group), Department of Biological Sciences, University of Calgary, Calgary, Alberta, Canada.
For primary bibliographic entry see Field 2H.
W88-10668

INPUT, MOVEMENT AND EXCHANGE OF ORGANIC MATTER WITHIN A SUBTROPICAL COASTAL BLACKWATER RIVER-FLOODPLAIN SYSTEM,
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W88-10669

DISSOLVED ORGANIC MATTER IN CUMBRIAN LAKES AND STREAMS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W88-10671

EPILITHIC BACTERIA IN AN ACID AND CALCAREOUS HEADSTREAM,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 2H.
W88-10673

FORCES ON MICROORGANISMS AT SURFACES IN FLOWING WATER,
Southampton Univ. (England). Dept. of Biology.
N. R. Silvester, and M. A. Sleigh.
Freshwater Biology, FWBLAB Vol. 15, No. 4, p 433-448, August 1985. 14 fig, 28 ref.

Descriptors: *Surface velocity, *Shear stress, *Sediment-water interfaces, *Lotic environment, *Microorganisms, *Boundary layers, Streams, Stream discharge, Reynolds number, Turbulent flow, Flow, Interfaces, Streamflow, Flow around objects, Flow velocity, Bacteria.

Surfaces in flowing water are covered by boundary layers within which the velocity of flow ranges between zero at the surface and the velocity of the main stream at the limits of the boundary layer. Many organisms are small enough to live entirely within the boundary layer and so are subjected to much smaller drag forces than if they were exposed to the main stream velocity. The form and extent of boundary layers at different stream velocities around selected structures, representing leaves and stems, have been calculated and presented graphically. These data provide a basis for the estimation of shear stresses on substrate surfaces and of forces exerted upon organisms of different sizes that live within the boundary layers aoround such surfaces, when exposed to different current velocities. Values for shear stresses on bacteria calculated in this way lie within the range of shear stresses required to detach bacteria from surfaces experimentally. (Author's abstract)
W88-10676

ACCLIMATION OF STREAM-BED HETEROTROPHIC MICROFLORA: METABOLIC RESPONSES TO DISSOLVED ORGANIC MATTER,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
For primary bibliographic entry see Field 2H.
W88-10680

LIFE HISTORY AND ECOLOGICAL ROLE OF THE XYLOPHAGOUS AQUATIC BEETLE, LARA AVARA, LECONTE (DRYOPOIDEA: ELMIDAE),
Oregon State Univ., Corvallis. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W88-10683

PATTERNS OF MACROINVERTEBRATE COLONIZATION ON FRESH AND SENESCENT ALDER LEAVES IN TWO MICHIGAN STREAMS,
Michigan State Univ., East Lansing. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W88-10684

LIMNOLOGICAL INVESTIGATIONS ON THE ROSETTA BRANCH OF THE NILE. I. ENVIRONMENTAL CONDITIONS,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 2H.
W88-10690

LIMNOLOGICAL INVESTIGATIONS ON THE ROSETTA BRANCH OF THE NILE: II. SEASONAL VARIATIONS OF NUTRIENTS,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 2H.
W88-10691

LIMNOLOGICAL INVESTIGATIONS ON THE ROSETTA BRANCH OF THE NILE: III. PHYTOPLANKTON,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 2H.
W88-10692

MACROINVERTEBRATE FAUNA OF AN ACID-STRESSED HEADWATER STREAM SYSTEM IN THE ADIRONDACK MOUNTAINS, NEW YORK,
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5C.
W88-10693

CORRELATES OF HABITAT FAVOURABILITY FOR BENTHIC MACROINVERTEBRATES AT FIVE STREAM SITES IN AN APPALACHIAN MOUNTAIN DRAINAGE BASIN, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-10695

EFFECTS OF OVERHEAD CANOPY ON MACROINVERTEBRATE PRODUCTION IN A UTAH STREAM,
Lake Superior State Coll., Sault Ste. Marie, MI. Dept. of Biology and Chemistry.
For primary bibliographic entry see Field 2H.
W88-10697

QUANTITATIVE OBSERVATIONS ON THE ABILITY OF EPIPHYTIC BACTERIA TO CONTRIBUTE TO THE POPULATIONS OF SUSPENDED BACTERIA IN TWO DISSIMILAR HEADSTREAMS,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 2H.
W88-10698

MOVEMENTS OF SELF-MARKED CADDISFLY LARVAE, CHYRANDA CENTRALIS (TRICHOPTERA: LIMNEPHILIDAE), IN A SIERRAN SPRING STREAM, CALIFORNIA, U.S.A.,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 2H.
W88-10704

DISTRIBUTION OF BREEDING DIPPERS (CINCLUS (L.); AVES) IN RELATION TO STREAM ACIDITY IN UPLAND WALES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5C.
W88-10706

SPATIAL VARIATION OF WATER TEMPERATURE CHARACTERISTICS AND BEHAVIOUR IN A DEVON RIVER SYSTEM,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W88-10710

SPATIAL AND TEMPORAL VARIATION IN THE MACROINVERTEBRATE FAUNA OF STREAMS OF THE NORTHERN JARRAH FOREST, WESTERN AUSTRALIA: FUNCTIONAL ORGANIZATION,
Western Australia Univ., Nedlands. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-10712

SUSPENDED BACTERIA IN CALCAREOUS AND ACID HEADSTREAMS: ABUNDANCE, HETEROTROPHIC ACTIVITY AND DOWNSTREAM CHANGE,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 2H.
W88-10713

GRADIENTS IN THE DISTRIBUTION OF RIVERINE BENTHOS,
Construction Engineering Research Lab. (Army), Champaign, IL.
For primary bibliographic entry see Field 2H.
W88-10719

DIATOM FLORA OF AN AUSTRALIAN RIVER SYSTEM: SPATIAL PATTERNS AND ENVIRONMENTAL RELATIONSHIPS,
Latrobe Valley Water and Sewage Board, Traralgon (Australia).
For primary bibliographic entry see Field 2H.
W88-10722

METABOLISM OF A SUB-TROPICAL LOW GRADIENT BLACKWATER RIVER,
Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-10728

RELATIONS BETWEEN SUSPENDED BACTERIA, EPIPHYTIC BACTERIA AND SUBMERGED VEGETATION OVER THE SPRING GROWING SEASON IN A CALCAREOUS HEADSTREAM,
Hull Univ. (England).
For primary bibliographic entry see Field 2H.
W88-10731

FACTORS AFFECTING THE MICRODISTRIBUTION OF GAMMARUS PULEX (AMPHIPODA): AN EXPERIMENTAL STUDY,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-10732

IMPORTANCE OF DISSOLVED ORGANIC MATTER PRODUCED BY DUCKWEED (LEMNA MINOR) IN A SOUTHERN ENGLISH RIVER,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W88-10734

ICTHYOFAUNAL CHECKLIST AND COMPARISON OF TWO NORTH BRANCH POTOMAC RIVER TRIBUTARIES WHERE ALLEGED OHIO-POTOMAC RIVER STREAM CAPTURES OCCURRED,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
For primary bibliographic entry see Field 2H.
W88-10746

DIFFUSIVE LIMIT FOR ENTRAINMENT,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W88-10763

EFFECT OF WHOLE-TREE HARVEST ON EPILITHIC BACTERIAL POPULATIONS IN HEADWATER STREAMS,
Michigan State Univ., East Lansing. Dept. of Zoology.
For primary bibliographic entry see Field 4C.
W88-10771

SURFACE AND SUBSURFACE WATER CONTRIBUTIONS DURING SNOWMELT IN A SMALL PRECAMBRIAN SHIELD WATERSHED, MUSKOKA, ONTARIO,
Trent Univ., Peterborough (Ontario). Watershed Ecosystems Program.
J. J. McDonnell, and C. H. Taylor.
Atmosphere-Ocean ATOCDA, Vol. 25, No. 3, p 251-266, September 1987. 8 fig, 1 tab, 39 ref.

Descriptors: *Snowmelt, *Surface water, *Groundwater movement, *Runoff, *Acid rain, *Hydrographs, Hydrologic models, Precambrian era, Streams, *Stream discharge, Ontario, Canada, Watersheds, Hydraulic conductivity.

The results of a detailed study and numerical analysis of the rates and pathways of snowmelt runoff processes are presented for a Precambrian watershed located in Muskoka, Ontario. This watershed has been gauged both chemically and physically since 1976 by the Ontario Ministry of the Environment as part of its Acid Precipitation in Ontario Study. Field data show that, in many areas, soils with very high hydraulic conductivities contributed significant amounts of subsurface flow to the hydrograph during and shortly after melt. Quickflow in the first phase of snowmelt was generated by a combination of saturation over land flow and saturated-unsaturated subsurface stormwater from shallow side slopes. However, most of the total water volume was delivered via slower groundwater flow. In the final phase of the melt period, the streamflow was mainly due to groundwater flow recharged on a forested area and delivered over limited distances through shallow, highly permeable overburden materials. Quickflow peaks superimposed on this general trend could be accounted for mainly as surface runoff over groundwater effluent areas mapped throughout the watershed. In support of ongoing hydrochemical studies by the Ontario Ministry of the Environment, these data and interpretations will aid in modifying and improving hydrologic submodels by adding to understanding of water movement in acidified watersheds. (Author's abstract)
W88-10777

HYDROGEOLOGICAL STUDY IN THE BASIN OF GULP CREEK, A RECONNAISSANCE IN A SMALL CATCHMENT AREA: PART 3. CHEMISTRY OF SURFACE AND GROUND WATER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 2F.
W88-10786

REGIONAL VARIATION IN THE CHEMICAL COMPOSITION OF SOIL AND DOMINANT AQUATIC PLANTS IN SHATT AL-ARAB, IRAQ,
Basrah Univ. (Iraq). Dept. of Plant Protection.
T. Y. Al-Edany, and A. H. A. Al-Mousawi.
Bangladesh Journal of Botany BJBTB3, Vol. 15, No. 1, p 87-94, June 1986. 3 fig, 2 tab, 14 ref.

Descriptors: *Chemical properties, *Soil chemistry, *Plant populations, *Aquatic plants, Biochemistry, Rivers, Sodium, Phosphorus, Nitrogen, Potassium, Physical properties, Regional analysis.

The chemical composition of soil and aquatic plants in the Shatt al-Arab river was studied upstream and downstream of Basrah, Iraq. An attempt was made to find the correlation between various properties of soil and chemical composition of plants at different stations and stages of growth. Organic carbon and sodium content of the soil showed obvious variation. Total nitrogen, phosphorus,potassium and sodium of analyzed plants showed slight variation, while biochemical constituents varied considerably. Some elements of the plants and soil have strong positive correlations while others have either weak or no correlation. The negative correlation can be explained on the basis of active growth and use of the specific ion from substratum and its accumulation in plants. In general, young plants have a weak or negative correlation. (Miller-PTT)
W88-10788

CHANNEL FORM AND PROCESSES IN BEDROCK AND ALLUVIAL REACHES OF THE RARITAN RIVER, NEW JERSEY,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W88-10794

SPATIAL AND TEMPORAL DISTRIBUTION OF SOME INTERESTING DIATOM SPECIES IN THE RIVER WYE SYSTEM, WALES, U.K.,
University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 2H.
W88-10799

STUDIES ON PHYTOPLANKTON OF THE NILE SYSTEM IN UPPER EGYPT,
Assiut Univ. (Egypt). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W88-10800

LONG-TERM TRENDS IN WATER CHEMISTRY OF THE VLTAVA RIVER (CZECHOSLOVAKIA),
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 5B.
W88-10813

DISSOLVED PHOSPHORUS DYNAMICS IN HEADWATER STREAMS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
Y. T. Prairie, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 200-209, February 1988. 8 fig, 5 tab, 44 ref.

Descriptors: *Cycling nutrients, *Streams, *Dissolved solids, *Phophorus, *Headwaters, Path of pollutants, Land use, Water temperature, Suspended sediments, Hydrologic models, Model studies, Catchments, Nutrients, Chemical properties, Geology, Seasonal variations, Stream pollution.

A comparative study of seven headwater streams was undertaken to evaluate the relative importance of land use, water discharge, water temperature, solar irradiance, and stream sediment resuspension on levels of dissolved phosphorus (DP). In six of the streams, DP concentration increased from early spring to late summer. Nutrient-rich streams are temporally more variable than nutrient-poor ones. Average DP were not related to the proportion of forest cover but showed a correspondence with underlying geology. Despite the restricted geographical area, relationships between DP conc. and water discharge varied in magnitude and in direction among the steams. Simple hydrological models treating the catchments as two-reservoir systems accounted for the different behaviors and performed satisfactorily when the effect of temperature was considered. The residual variance showed no seasonal trends but was significantly correlated with daily solar irradiance for one of the seven streams. Finally, the hypothesis that resuspension of stream sediments affects soluble phosphorus concentration was experimentally rejected. (See also W88-10826) (Author's abstract)
W88-10825

PARTICULATE PHOSPHORUS DYNAMICS IN HEADWATER STREAMS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
Y. T. Prairie, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 210-215, February 1988. 6 fig, 4 tab, 34 ref.

Descriptors: *Cycling nutrients, *Streams, *Particulate matter, *Phophorus, *Headwaters, Stream gradient, Hydrologic models, Model studies, Chemical properties, Dynamics, Physical properties.

The authors examined the dynamics of particulate phosphorus (PP) in seven headwater streams of southern Quebec draining catchments differing in size, extent of forest cover, and stream channel gradient. The extent of forest cover can be used to predict average PP. The magnitude of the temporal fluctuations (variance) in PP conc. was strongly related to mean levels. While most streams showed positive relationships between discharge and PP concentration in rain events, inverse relations were observed in two streams and possibly the result of rapid exhaustion of PP. Inverse relationships were also seen in these two streams for samples collected outside rain events. The authors present a model based on channel gradient and extent of forest cover to predict the slope coefficient of PP - discharge relationships and also the occurrence of very rapid exhaustion. They then extend this model to include the influence of precipitation history and catchment size on PP in headwater streams. This model accounted for 60% of the variation of the pooled observations from all seven streams and is comparable in predictive power with stream-specific models published elsewhere in the literature. (See also W88-10825) (Author's abstract)
W88-10826

INFLUENCE OF SEASONAL RIVER DISCHARGE ON SURVIVAL OF JUVENILE ATLANTIC SALMON, SALMO SALAR,
Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch.
For primary bibliographic entry see Field 2H.
W88-10836

DISCHARGE-TIME METHOD. A NEW TECHNIQUE FOR SAMPLING PLANKTON IN FLUVIAL SYSTEMS, WITH A NOTE ON THE MODIFIED PLANKTON SAMPLING DEVICE,
Garhwal Univ., Srinagar (India). Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W88-10857

EFFECT OF THE CROSS-SECTIONAL SHAPE OF A CANAL ON THE PARAMETERS OF STEEP TRAVELING SURGES,
For primary bibliographic entry see Field 8C.
W88-10880

EPILITHIC ALGAL NITROGEN FIXATION, STANDING CROPS AND PRODUCTIVITY IN FIVE RIVERS FLOWING THROUGH THE OILSANDS REGION OF ALBERTA/CANADA,
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W88-10889

EXAMINATION OF SURFACE WATERS USED A SOURCES OF SUPPLY IN THE PORT HARCOURT AREA: II. CHEMICAL HYDROLOGY,
Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria). Microbiology Div.
For primary bibliographic entry see Field 5F.
W88-10891

MEASURING HYDRAULIC CONDUCTIVITY OF SEDIMENTS IN A RIVER WITH A FLUCTUATING LEVEL,
Bostock Engineering Services, Toronto (Ontario).
For primary bibliographic entry see Field 2F.
W88-10977

LINKED STREAM-AQUIFER SYSTEM MODEL,
Dames and Moore, Golden, CO.
For primary bibliographic entry see Field 2A.
W88-10985

FLUVIAL PROCESSES IN DRYLAND RIVERS,
Arizona State Univ., Tempe. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W88-11030

HYDROGEOCHEMICAL ANALYSIS OF COLD CREEK AND BLAYNE SPRING, ENNIS, MONTANA,
Greiner Engineering Sciences, Inc., Tampa, FL.
K. S. Monks, P. Pushkar, and G. J. Kenoyer.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 237-265. 5 fig, 8 tab, 23 ref.

Descriptors: *Geohydrology, *Hydrologic data collections, *Water analysis, *Water quality, *Fish hatcheries, *Potential water supply, *Streams, Cations, Anions, Heavy metals, Inorganic compounds, Trout, Montana.

A hydrogeochemical reconnaissance stream water survey for dissolved inorganic species was conducted in waters which drain basalt and limestone terrains in Madison County, Montana. The purpose of this investigation was to determine whether the water of Cold Creek is suitable as an alternative or additional supply for broodstock at the Ennis National Fish Hatchery. Samples collected during summer, baseflow in 1984 from Cold Creek, Blayne Spring, and the Fish Hatchery intake, were analyzed for major cations, anions and heavy metals (Ca, Mg, Si, Na, K, SO4, Cl, NO3, F, Al, B, Ba, Cd, Cu, Cr, Fe, Pb, Mn, Ni, Ag, Sr, Ti, Zn). Inorganic chemical analyses reveal that the chemical quality of Cold Creek can provide an adequate source of water during the summer months when low flow conditions prevail. Concentrations of Cu, Pb, and Zn slightly exceed EPA recommendations for trout at specific points along the reach of Cold Creek, probably as a result of ground water influx from localized scattered sulfide deposits. However, as a result of ground water dilution downstream, heavy metals are expected to be within the optimal range of concentration at the stream base, where water would be intercepted by the fish hatchery as an additional or alternate supply. As a result of sporadic high concentrations of Ag, Cu, Pb and Zn, additional monitoring of these dissolved heavy metals is recommended. (See also W88-11121) (Author's abstract)
W88-11133

AERATION AT OVERFLOW WEIRS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5G.
W88-11269

1986 ANNUAL REPORT FROM THE WATER BUDGET MANAGERS,
Fish Passage Center, Portland, OR.
For primary bibliographic entry see Field 6D.
W88-11272

CAMAS CREEK (MEYERS COVE) ANADROMOUS SPECIES HABITAT IMPROVEMENT PLAN,
Salmon National Forest, ID.
For primary bibliographic entry see Field 8I.
W88-11275

ANALYSIS OF ALTERNATIVE FISH TRANSPORTATION STRATEGIES,
For primary bibliographic entry see Field 8I.
W88-11276

ASSESSMENT OF PHOSPHORUS IN CONODOGUINET CREEK, CUMBERLAND COUNTY, PENNSYLVANIA,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W88-11286

METHANE FLUX FROM THE CENTRAL AMAZONIAN FLOODPLAIN,
College of William and Mary, Williamsburg, VA. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-11288

EXPERIMENTAL FLUVIAL GEOMORPHOLOGY,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 2J.
W88-11289

2F. Groundwater

PROBABILISTIC ANALYSIS OF POREWATER PREDICTIONS FOR UNSTEADY GROUNDWATER FLOW ON A SLOPING BED,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
I. M. Lee.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8612389. Ph.D. Dissertation, 1986. 160 p, 46 fig, 45 ref, 2 append.

Descriptors: *Landslides, *Model studies, *Stochastic process, *Unsteady flow, *Probabilistic process, *Groundwater movement, *Groundwater runoff, Slopes, Flow profiles, Bedrock, Darcys law, Finite difference methods, Computer programs, Numerical analysis.

A stochastic model is developed for the prediction of the groundwater surface of the unsteady flow in a shallow soil cover on a sloping impervious bedrock. The spatial and temporal variation of the groundwater surface due to the spatial variation of the permeability, the specific yield, the depth of soil cover, the topography of ground surface, and the derived from Darcy's law and the continuity equation. The flow is modified to include the effect of bedrock topography. An explicit finite difference scheme is used to solve the derived governing equation. The developed models are applied to a hillslope in Alaska. The results can be used in reliability analysis for assessing the risk of landslides on hillside slopes. The formulation is general in nature and can also be used in cases where there is a change in slope, nonstationary processes, or heterogeneous soil deposits. (Cremmins-AEPCO)
W88-10092

GROUNDWATER TRANSPORT OF CHLOROPHENOLICS THROUGH A HIGHLY FRACTURED SOIL AT ALKALI LAKE, OREGON,
Oregon Graduate Center, Beaverton.
For primary bibliographic entry see Field 5B.
W88-10094

EFFECTS OF FLY ASH AND FLUE-GAS DESULFURIZATION WASTES ON GROUNDWATER QUALITY IN A RECLAIMED LIGNITE STRIP MINE DISPOSAL SITE,
North Dakota Univ., Grand Forks. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-10099

SEASONAL WATER BALANCE COMPONENTS IN HYDROLOGICAL REGIONALIZATION,
Finnish Meteorological Inst., Helsinki.
For primary bibliographic entry see Field 2E.
W88-10119

GEOELECTRICAL PROPERTIES OF SELECTED ROCK AND WATER SAMPLES FROM SAN SALVADOR ISLAND, BAHAMAS,
Akron Univ., OH. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W88-10169

CHEMICAL COMPOSITION OF THE WATER IN THE RIVER MALA PANEW, AND ITS TRIBUTARIES, AND OF THE GROUND WATER IN ITS BASIN IN THE UPPER SILESIAN INDUSTRIAL REGION (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10364

GROUND INFLOW OF NUTRIENTS FROM CATCHMENT AREAS INTO TWO LAKES OF THE LECZYNSKO-WLODAWSKIE LAKE DISTRICT OVER A PERIOD OF THREE YEARS,
Akademia Rolnicza, Lublin (Poland). Inst. of Soil Science and Agricultural Chemistry.
For primary bibliographic entry see Field 5B.
W88-10365

VICTORIA PROVINCE DROUGHT RELIEF PROJECT: II. BOREHOLE YIELD RELATIONSHIPS,
Hydrotechnica, Shrewsbury (England).
J. F. T. Houston, and R. T. Lewis.
Groundwater GRWAAR, Vol. 26, No. 4, p 418-426, July-August, 1988. 12 fig, 7 tab, 12 ref.

Descriptors: *Boreholes, *Geologic mapping, *Well yield, *Zimbabwe, *Unconsolidated aquifers, *Geohydrology, *Groundwater availability, *Aquifer characteristics, Aquifer systems, Bedrock, Groundwater level, Water resources development, Rainfall, Altitude, Groundwater movement, Geologic fissures, Geologic joints, Victoria Province.

Composite aquifers composed of relatively high storage, low permeability regolith overlying low storage, higher permeability fissured bedrock occur in the Basement terrain of Victoria Province. The adequacy of these aquifers for rural-water supplies is variable and locating optimum borehole sites is difficult. The analysis of data from the Victoria Province Drought Relief Project suggests that a variety of environmental factors influence borehole yield. Despite the wide scatter of data, certain generalizations can be made using statistical techniques. The results show that for regolith aquifers specific capacity increases with rainfall, regolith thickness, and altitude, which is in turn probably related to the age of the erosion surface. In fissured bedrock aquifers the upper 20 m is crucial for the provision of an adequate yield. (Author's abstract)
W88-10414

RECHARGE-DISCHARGE FUNCTION OF WETLANDS NEAR JUNEAU, ALASKA: PART I. HYDROGEOLOGICAL INVESTIGATIONS,
Syracuse Univ., NY. Dept. of Geology.
D. I. Siegel.
Groundwater GRWAAR, Vol. 26, No. 4, p 427-434, July-August, 1988. 4 fig, 42 ref.

Descriptors: *Groundwater recharge, *Mendenhall Valley, *Groundwater discharge, *Surface-groundwater relations, *Mendenhall Valley, *Wetlands, *Geohydrology, Bogs, Muskeg, Fens, Piezometers, Hydraulic conductivity, Alaska Groundwater movement, Computer models, Soil water, Forests.

Water levels in piezometers and the hydraulic conductivity of organic and mineral soils were measured during spring and summer 1986 to evaluate the recharge-discharge function of wetlands in the vicinity of the Mendenhall Valley near Juneau, Alaska. Computer modeling experiments were also done to evaluate the function of a large patterned fen. The blanket bogs are probably recharge zones, whereas forested wetlands are discharge zones. Approximately the upper third of the patterned fen is a ground-water recharge zone, whereas its northern margin receives ground-water discharge from flow systems recharged on moraines. The amounts of wetland recharge and discharge are very small. Recharge from wetlands to viable aquifers is probably less than 1% of the total annual recharge to the aquifer system. The amount of ground-water discharge to streams from wetlands is too small to measure. (Author's abstract)
W88-10415

AUTOMATED NUMERICAL EVALUATION OF SLUG TEST DATA,
Shell Development Co., Houston, TX.
M. W. Kemblowski, and C. L. Klein.
Groundwater GRWAAR, Vol. 26, No. 4, p 435-438, July-August, 1988. 4 fig, 1 tab, 3 ref.

Descriptors: *Numerical analysis, *Aquifer testing, *Pumping tests, *Hydraulic conductivity, *Algorithms, *Slug tests, *Aquifer characteristics, Data interpretation, Mathematical models, Test wells, Kalkaska, Michigan, Field tests, Automation.

Development of a numerical algorithm to analyze slug test data is described. The procedure was based on the sensitivity analysis for parameter estimation. Numerical procedures are very popular for aquifer testing, primarily because of their simplicity. Many such tests are performed to estimate the hydraulic conductivity values of ground-water-bearing formations. Those values in turn are used to calculate pore-water velocities. The algorithm was coded and successfully tested for a hypothetical data set. It has also been applied at a number of field locations. One such application, at a Kalkaska, Michigan site is presented. The simulated results fit the field data quite well. (Author's abstract)
W88-10416

RECHARGE FROM A RIVER OF LARGE WIDTH TO A SHALLOW WATER-TABLE AQUIFER,
National Inst. of Hydrology, Roorkee (India).
G. C. Mishra, and S. M. Seth.
Groundwater GRWAAR, Vol. 26, No. 4, p 439-444, July-August, 1988. 5 fig, 18 ref.

Descriptors: *Groundwater recharge, *Surface-groundwater relations, *Riparian water loss, *Unconfined aquifers, *Mathematical models, *Mathematical analysis, *Reach transmissivity, Subsurface mapping, Seepage, Mathematical eequations, Rivers, Aquifers, Stage-discharge relations, Water table.

Using Zhukovsky's function and the Schwarz-Christoffel conformal mapping technique, unconfined seepage from a river of large width has been analyzed for a steady-state condition. Seepage quantities occurring through the bed and the bank of the river have been estimated separately. The reach transmissivity constant for a river with large width has been determined. It is found that if the distance between the riverbank and the observation well is more than 0.5 D sub i, where D sub i is the saturated thickness of aquifer below the riverbed, the reach transmissivity constant is independent of drawdown at the observation well. The reach transmissivity constant depends on the depth of water in the river and the distance of the observation well from the riverbank. (Author's abstract)
W88-10417

ARTIFICIAL TRACER TECHNIQUES FOR THE DETERMINATION OF THE STRUCTURE OF CONDUIT AQUIFERS,
University of Western Ontario, London. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-10418

ANALYSIS OF SUSTAINED GROUND-WATER WITHDRAWALS BY THE COMBINED SIMULATION-OPTIMIZATION APPROACH,
Alberta Environment, Edmonton. Earth Sciences Div.
T. S. Chau.
Groundwater GRWAAR, Vol. 26, No. 4, p 454-463, July-August, 1988. 8 fig, 1 tab, 17 ref.

Descriptors: *Water yield, *Groundwater potential, *Confined aquifers, *Mathematical analysis, *Simulation analysis, Mathematical models, Finite element method, Groundwater movement, Groundwater management, Groundwater availability, Selective withdrawal, Management planning, Optimization, Cold Lake-Beaver River, Alberta.

The long-term ground-water withdrawal potential of a regional confined aquifer in the Cold Lake (Alberta, Canada) area is analyzed with a combined simulation-optimization model. The Galerken finite-element method is used in the simulation model to obtain numerical approximations to the

hydraulics of ground-water flow. This method produces a set of linear algebraic equations containing ground-water variables which are embedded as equality constraints within the constraint set of a linear programming optimization model. Other constraints in this set include restrictions on drawdown, water demand, and hydraulic gradient. The objective of the optimization model is to maximize total withdrawal from potential ground-water development sites. The objectives of this modeling study are to assist planners and water managers in formulating a long-term water management plan on water allocation to industrial users and to establish a long-term withdrawal limit for the aquifer. Analyses include the determination of users' ground-water withdrawals to maximize total ground-water use from the aquifer, the analysis of ground-water supply tradeoff among water users, and the identification of pumping locations and their pumpages that best intercept ground-water flow in the aquifer system. Modeling results show that there is an interdependency of optimal ground-water withdrawals among water users. The maximum total withdrawal obtained from potential ground-water development sites is 90 percent of total inflow into the aquifer. This withdrawal limit for the aquifer can be increased with a new set of sites chosen for ground-water development. (Author's abstract)
W88-10419

CHARACTERIZING JOINTED SYSTEMS BY AZIMUTHAL RESISTIVITY SURVEYS,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
R. W. Taylor, and A. H. Fleming.
Groundwater GRWAAR, Vol. 26, No. 4, p 464-474, July-August, 1988. 15 fig, 1 tab, 36 ref.

Descriptors: *Geohydrology, *Geologic joints, *Azimuthal resistivity surveys, *Geophysics, *Aquifer characteristics, *Resistivity, Anisotropy, Networks, Electrodes, Wisconsin, Performance evaluation, Directional connectivity, Porosity, Subsurface mapping, Field tests.

Anisotrophy, directional connectivity, and porosity of fracture systems can be estimated from surface azimuthal electrical resistivity surveys. Azimuthal resistivity surveys utilize conventional resistivity equipment and are performed by rotating a Wenner array about a fixed center point and measuring apparent resistivity as a function of azimuth. The depth of investigation is determined by the electrode spacing which is generally limited by practical considerations to approximately 70 m. The azimuthal survey generates an apparent resistivity ellipse from which the properties of a subsurface joint system can be determined. Theoretically the major axis of the resistivity ellipse will coincide with strike of the primary joint set. The ratio of major axis to minor axis of the ellipse defines the coefficient of anisotrophy associated with the joints, and from this coefficient, secondary porosity can be calculated. Application of azimuth surveys at 60 sites in bedrock and clayey till throughout Wisconsin generally yielded joint strikes within a few degrees of direct observations. Calculated porosities were reliable for the bedrock , but not for the tills. Although the theoretical foundation for this technique is based on idealized jointing, the field results indicate that the method is effective in media with multiple joint sets. When mean joint length exceeds the electrode spacing, azimuthal resistivity peaks closely coincide with the mean strikes of observed joint sets. When joint lengths are less than the electrode spacing, the major ellipse axis indicates the most conductive path through the joint system. In both cases, ellipse shape indicates the direction(s) having the greatest joint connectivity, which are also the directions of greatest aquifer permeability. (Author's abstract)
W88-10420

SIMULATION OF BIODEGRADATION AND SORPTION PROCESSES IN GROUND WATER,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-10421

EFFECTIVENESS OF VARIOUS AQUIFER RESTORATION SCHEMES UNDER VARIABLE HYDROGEOLOGIC CONDITIONS,
H and A of New York, Rochester.
For primary bibliographic entry see Field 5G.
W88-10422

AUTOMATED COMPUTATION OF PARAMETERS FOR LEAKY CONFINED AQUIFERS,
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
A. Mukhopadhyay.
Groundwater GRWAAR, Vol. 26, No. 4, p 500-504, July-August, 1988. 1 fig, 6 tab, 5 ref.

Descriptors: *Confined aquifers, *Leaky aquifers, *Computer programs, *Groundwater movement, *Geohydrology, *Numerical analysis, Automation, Transmissivity, Leakage, Storage coefficient, Fortran, Sensitivity analysis, Pumping tests, Aquifer characteristics.

A FORTRAN program was developed to obtain the transmissivity, storage coefficient, and leakage factor for a leaky confined aquifer from pumping test data. The automated method computes the aquifer parameters faster and without bias when compared with the manual curve-matching methods commonly used. Aquifer parameters obtained from published pumping test data using the software compare closely with those estimated by manual curve-matching methods. The automated method cannot, however, detect the presence of recharge/discharge boundaries within the area of investigation or large deviations of data due to errors in data collection or data recording. (Author's abstract)
W88-10423

TRILINEAR DIAGRAM REVISITED: APPLICATION, LIMITATION, AND AN ELECTRONIC SPREADSHEET PROGRAM,
Arizona Univ., Tucson. Dept. of Geosciences.
For primary bibliographic entry see Field 7C.
W88-10424

HYDROGEOLOGY OF THE BISCAYNE AQUIFER,
Florida Atlantic Univ., Boca Raton. Dept. of Geology.
I. Watson, and J. W. Herr.
Florida Scientist FLSCA, Vol. 48, No. 3, p 154-161, Summer 1985. 4 fig, 1 tab, 3 ref.

Descriptors: *Geohydrology, *Groundwater hydrology, *Biscayne aquifer, *Permeability, *Florida, *Aquifer characteristics, Aquifer testing, Hydraulic conductivity, Hydrologic data collections, Heterogeneity, Core logging, Pumping tests, Aquifers.

The Biscayne aquifer is the sole-source aquifer in south east Florida. Since it is unconfined and highly permeable, it is readily susceptible to contamination. Furthermore, because of its heterogeneous nature, any quantitative prediction of water supply, or of the migration and attenuation of contaminating leachates within the aquifer can be based only on detailed local studies of the type outlined. The data presented are compiled from rigorous investigations at two sites near Homestead and present new information on the Biscayne aquifer in south Dade county. The studied area transmissivity value of 85,000 sq m/day was obtained from a large-scale pit test and well pumping tests. Other data were derived from the detailed logging of bore-hole cores, thin-section analyses, laboratory permeability tests and field-pumping tests. (Author's abstract)
W88-10443

NATURAL NITRATE REMOVAL FROM GROUNDWATERS. POSSIBILITY OF APPLICATION TO THE RECLAMATION OF GRAVEL PIT LAKES (EPURATION NATURELLE DES NITRATES DES EAUX SOUTERRAINES: POSSIBILITES D'APPLICATION AU REAMENAGEMENT DES LACS DE GRAVIERES),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 5G.
W88-10474

ELECTRIC LOG INTERPRETATION FOR THE EVALUATION OF SALT WATER INTRUSION IN THE EASTERN NIGER DELTA,
Ilorin Univ. (Nigeria). Dept. of Geography.
A. U. Oteri.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 1, p 19-30, February 1988. 6 fig, 1 tab, 22 ref.

Descriptors: *Sediments, *Niger Delta, *Saline water intrusion, *Deltas, *Saline-freshwater interfaces, *Hydrology, Geohydrology, Salinity, Mapping, Well logs, Nigeria, Aquifer characteristics, Connate water.

The Niger Delta (75 000 sq km) comprises a thick (up to 9000 m) sequence of clastic sediments subdivided into the Akata, Agbada and Benin Formations in ascending order. Sands of the Benin Formation constitute aquifers which have been exploited for water supply, although in parts of the delta many of them have been abandoned due to high salinity. Interpretation of 267 oilwell logs for delineating the fresh water-bearing aquifers is reported here. While fresh water sands occur at the upper zone of the Benin Formation in most places, saline water sands were found at the upper zone at depths (ranging from 30 to 947 m) in two well-defined areas, underlain by fresh water sands. The saline water is thought to be connate. The fresh water/saline water interface has been mapped throughout the eastern Niger Delta and is found to be deepest (2237 m) 44 km westsouthwest of Port Harcourt. (Author's abstract)
W88-10484

RELIABLE YIELD OF UNCONFINED AQUIFERS,
Bangladesh Agricultural Univ., Mymensingh. Dept. of Irrigation and Water Management.
L. R. Khan, and J. A. Mawdsley.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 2, p 151-171, April 1988. 6 fig, 4 tab, 39 ref.

Descriptors: *Unconfined aquifers, *Aquifer yield, *Model studies, *Safe yield, *Water yield, *Geohydrology, Catchment areas, River Itchen, England, Lumped yield model, Seasonal variation, Prediction, Mathematical studies, Hydrology, Water resources development, Statistical methods, Risks, Aquifers, Groundwater recharge, Groundwater.

The various definitions of aquifer yield are reconsidered and criticized because the risk of shortages is not quantified. The concept of reliable yield is introduced and a model is proposed that can be used to estimate the yield of an unconfined aquifer to a specified annual reliability. The model is a lumped model which is suitable for the preliminary estimates of aquifer yield required at the early planning stage of water resource development. The model requires as input the recharge for various durations which will be exceeded a specified percentage of the time. Standard statistical analysis of the extreme low flow events of various durations is used to obtain these values. Using recharge data from several unconfined aquifers in the England, the lognormal distribution was found to be the most suitable distribution to describe the recharge. The lumped yield model requires several assumptions. These are discussed and sensitivity of the yield to them was investigated using data from the River Itchen catchment, a chalk catchment in the south of England. The yield was found to be sensitive to several of the assumptions. (Author's abstract)
W88-10491

GROUNDWATER MONITORING NETWORK RATIONALIZATION USING STATISTICAL ANALYSES OF PIEZOMETRIC FLUCTUATION,
Agriculture and Water Resources Research Centre, Baghdad (Irag).
For primary bibliographic entry see Field 7A.
W88-10493

SHALLOW-PROBE SOIL-GAS SAMPLING FOR INDICATION OF GROUND-WATER CONTAMINATION BY CHLOROFORM,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-10523

ANALYSIS OF SUBSURFACE STRATIGRAPHY OF THE SANITARY LANDFILL, URBANA, ILLINOIS,
Illinois Univ., Urbana. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-10551

DENITRIFICATION IN A SAND AND GRAVEL AQUIFER,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-10737

SALINE MINEWATERS OF THE KEWEENAW PENINSULA, NORTHERN MICHIGAN: THEIR NATURE, ORIGIN, AND RELATION TO SIMILAR DEEP WATERS IN PRECAMBRIAN CRYSTALLINE ROCKS OF THE CANADIAN SHIELD,
Michigan Univ., Ann Arbor. Dept. of Geological Sciences.
W. C. Kelly, R. O. Rye, and A. Livnat.
American Journal of Science AJSCAP, Vol. 286, No. 4, p 281-308, April 1986. 11 fig, 1 tab, 70 ref. NSF Grants DES-74-21807 and EAR-80-25263.

Descriptors: *Michigan, *Connate water, *Saline water, *Groundwater, *Michigan, *Precamerian era, *Brines, *Keweenaw Peninsula, *Isotope studies, Water chemistry, Infiltration, Temperature effects, Geohydrology, Geologic fractures, Canadian shield.

In the Keweenaw Peninsula, the minewaters are isotopically different from the late Precambrian meteoric and burial metamorphic waters of the region and could not reasonably have evolved therefrom. They are also distinctly different from, and surely older than, local Pleistocene waters. Fluid inclusions in the Keweenaw copper deposits are chemically similar to the minewaters, but their Sigma D values increase systematically with sample depth, indicating contamination by surface waters, probably in Precambrian time. Furthermore, there is no viable mechanism for collecting these inclusion waters into large quantities of brine with salinities as high as 30 wt percent. This paper advocates a basinal water model involving several stages: (1) initial evolution of the waters as Paleozoic-hosted formation waters, (2) deep infiltration, reaction, and 'self-sealing' of these brines in basement rocks under conditions of relatively high temperature and water recharge, (3) removal of Paleozoic cover and backreaction of the waters, chemically and isotopically, under new conditions of low temperature and water recharge, and (4) subsequent and variable mixing with fresh meteoric waters. In the Keweenaw Peninsula, stages (1) and (2) must have occurred by Late Jurassic time while a Paleozoic cover still existed. Viewed in this framework, the brine pockets are essentially large 'fluid inclusions' in which the liquid phase is evolved basinal water and the host a grouted silicate rock. Like most inclusion liquids in oxygen-bearing minerals, these brines have, upon cooling, back-exchanged with their host over a prolonged period of time. Geologically, this model provides a common denominator (Paleozoic cover) for the otherwise diverse settings in which the saline waters occur today. It accounts for the many similarities between Paleozoic formation waters and the basement brines, while explaining their significant differences. (Author's abstract)
W88-10755

SURFACE AND SUBSURFACE WATER CONTRIBUTIONS DURING SNOWMELT IN A SMALL PRECAMBRIAN SHIELD WATERSHED, MUSKOKA, ONTARIO,
Trent Univ., Peterborough (Ontario). Watershed Ecosystems Program.
For primary bibliographic entry see Field 2E.
W88-10777

HYDROGEOLOGICAL STUDY IN THE BASIN OF GULP CREEK, A RECONNAISSANCE IN A SMALL CATCHMENT AREA: PART 3. CHEMISTRY OF SURFACE AND GROUND WATER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
D. J. G. Nota, A. M. G. Bakker, B. VanDeWeerd, and G. Halma.
Agricultural University Wageningen Papers, Vol. 87, No. 7, p 1-46, 1987. 22 fig, 4 tab, 10 ref.

Descriptors: *Geohydrology, *Path of pollutants, *Catchment areas, *Surface water, *Groundwater pollution, *Aquifer characteristics, Seasonal variation, Drought, Nitrates, Lithology, Water pollution sources, Catchment basins, Temporal distribution.

The chemistry of surface and groundwater in the basin of Gulp Creek, located in the southeastern part of the Netherlands and adjacent Belgium, was studied to detect the adverse effects of man's activities. During the extended sampling period, from 1975 to 1985, the effects of temporal variations in water composition and their significance in terms of aquifer characteristics could be recognized. The temporal variations illustrate the normal seasonal effects as well as the behavior of the aquifer during and after a period of severe drought (1975 and 1976). The variations in concentration and flux of individual ions made it possible to distinguish the dynamic interrelationship between the flow types and flow routes of the water passing through the basin. During the wet season, interflow along the hillslopes was found to be important in flushing pollutants (like nitrate) out of the regolith towards the stream. A new rectangular diagram was introduced and proved to be most useful for plotting several entire water analyses because it is easy to read and shows proportional as well as absolute values. The low degree of pollution in surface waters compared to the severely contaminated ground water at a number of well sites is considered to be the result of dilution by deeper groundwater and may also be associated with assimilation processes in the surface stream. Shallow wells along the valley slope and in the valley bottom were very vulnerable to pollution in catchments with pronounced relief. (Miller-PTT)
W88-10786

PALEOHYDROLOGY OF THE SEDIMENTATION BASIN IN SENEGAL: ESSAY RELATING TO DEPRESSED NAPPES (PALEOHYDROLOGIE DU BASSIN, SEDIMENTAIRE DU SENEGAL: ESSAI D'EXPLICATION DE NAPPES DEPRIMEES),
Public Health Inst. of Slovenia, Lujubijana (Yugoslavia).
B. Dieng.
La Houille Blanche, No. 1, p 53-60, 1988. 6 fig, 1 ref. English summary.

Descriptors: *Sedimentation, *Basins, *Paleohydrology, Simulation model, Nappes, Senegal.

A hydrological simulation model was used to study the stratigraphy and geohydrology of the sedimentation basin in Senegal. The study covered a period of 18,000 years prior to our era. (Author's abstract)
W88-10907

PROCEEDINGS OF THE NWWA CONFERENCE ON SOLVING GROUND WATER PROBLEMS WITH MODELS.
Denver, Colorado. February 10-12, 1987. National Water Well Association, Dublin, OH. 1987. Two volumes, 1534 p.

Descriptors: *Conferences, *Groundwater movement, *Path of pollutants, *Model studies, *Solute transport, Hazardous wastes, Radioactive wastes, Wells, Groundwater management, Mathematical models, Aquifers, Geohydrology, Hydrologic models, Waste disposal, Landfills, Computer programs, Hydraulic conductivity.

The National Water Well Association (Association of Ground Water Scientist and Engineers Division) and the International Ground Water Modeling Center sponsored a forum for information exchange among model developers and users in order to narrow the gap between model development and application. Topics of papers included new developments in biochemical and geochemical models, groundwater management models, regulatory use of models, application of models to engineering practice, unsaturated flow processes, salt water intrusion, two- and three-dimensional groundwater modeling, numerical methods, groundwater contamination from hazardous waste sites (including radioactive wastes), analytical models, and regional groundwater models. (See W88-10912 thru W88-10990) (Cassar-PTT)
W88-10912

TECHNOLOGY TRANSFER IN GROUNDWATER MODELING: THE ROLE OF THE INTERNATIONAL GROUND WATER MODELING CENTER,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 4B.
W88-10913

MODELING MASS TRANSPORT WITH COMPETITIVE ION EXCHANGE,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-10914

DEVELOPMENT AND APPLICATION OF A MODEL FOR SIMULATING MICROBIAL GROWTH DYNAMICS COUPLED TO NUTRIENT AND OXYGEN TRANSPORT IN POROUS MEDIA,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-10915

DEVELOPMENT AND APPLICATION OF A COUPLED GEOHYDROCHEMICAL CODE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-10916

SIMULATION WITH A COMPLEXATION-ADSORPTION MODEL OF POSSIBLE EFFECTS OF DISSOLVED HUMIC SUBSTANCES ON SOLUTE TRANSPORT IN SOILS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W88-10917

NUMERICAL SIMULATION OF MICROBIAL BIODEGRADATION OF HYDROCARBONS IN GROUND WATER,
Rice Univ., Houston, TX. Dept. of Mathematical Sciences.
For primary bibliographic entry see Field 5B.
W88-10918

EXTENSION OF GEOCHEMICAL MODELLING TECHNIQUES TO BRINES: COUPLING OF THE PITZER EQUATIONS TO PHREEQE,
Alberta Univ., Edmonton. Dept. of Geology.
A. S. Crowe, and F. J. Longstaffe.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 110-129, 4 fig, 27 ref.

Descriptors: *Geochemistry, *Groundwater, *Brines, *Model studies, *Chemical precipitation, Mathematical models, PHREEQE model, Porous media, Sedimentary basins, Mass transfer, Solute transport, Ions, Pitzer equations, Temperature.

A modeling technique (PHREEQE) was extended to handle conditions found in deep sedimentary basins, where brines of 150 C can cause a decrease

in porosity and/or permeability of the porous media due to precipitation or dissolution of minerals. PHREEQE compensates for the major limitations of current geochemical codes under these conditions: inappropriate equations for calculation of the activity coefficient and inadequate data base with respect to ion pairs. The Pitzer equations, which account for the effects of ion pairing and the electrostatic changes that occur as salinity increases, were incorporated into the geochemical code. A data base of about 50 minerals which occur in clastic sedimentary rocks was compiled. Ion pairs were not needed in the data base because stoichiometric activity coefficients were calculated using the Pitzer equations rather than activity coefficients for individual ions. (See also W88-10912) (Cassar-PTT)
W88-10919

SENSITIVITY ANALYSIS OF OPTIMAL GROUND WATER CONTAMINANT CAPTURE CURVES: SPATIAL VARIABILITY AND ROBUST SOLUTIONS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W88-10920

DOUBLE-POROSITY TRACER-TEST ANALYSIS FOR INTERPRETATION OF THE FRACTURE CHARACTERISTICS OF A DOLOMITE FORMATION,
INTERA Technologies, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.
W88-10921

APPLICATION OF UNCERTAINTY ANALYSIS TECHNIQUES TO ADDRESS NRC TRAVEL TIME PERFORMANCE MEASURES AT A POTENTIAL HLW DISPOSAL SITE IN DEAF SMITH COUNTY, TEXAS,
INTERA Technologies, Inc., Austin, TX.
R. W. Andrews, A. M. LaVenue, B. M. Thompson, and J. E. Campbell.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 191-216, 10 fig, 2 tab, 23 ref. Battelle Memorial Institute Contract E512-11600, Dept. of Energy Contract DE-AC02-83CH10140.

Descriptors: *Travel time, *Groundwater movement, *Waste disposal, *Radioactive wastes, *Model studies, Deaf Smith County, Texas, Uncertainty analysis, Mathematical models, PTRACK model, Permeability, Geohydrology, Statistical analysis, Probability distribution.

A probabilistic approach based on statistical sampling was used to produce a probability distribution function for travel time of groundwater at a proposed radioactive waste depository site. This was used to quantify the uncertainties in the predictions which are a results of (1) lack of site-specific hydrogeologic data, (2) spatial variability of hydrogeologic parameters, and (3) model uncertainty. The approach involved conducting multiple simulations of the expected groundwater travel path and travel time by sampling from distributions of the uncertain hydrogeologic properties of the system. The actual travel path and travel time are functions of (1) the horizontal and vertical hydraulic gradients in each hydrostratigraphic unit which in turn are functions of the pressure and density distributions within each unit, (2) the thickness of each unit, (3) the horizontal and vertical permeability of each unit, and (4) the effective porosity of each unit. Results of uncertainty analysis at the Deaf Smith County, Texas, site indicated that the median travel time to a 5-km accessible environment was 500,000 years. The probability of travel time being less than 1000 years was <0.001; the probability of travel time being less than 10,000 years was 0.015. The principal factor affecting the travel time distribution was the permeability of the interbed immediately below the host salt. These results were considered to be conservative with respect to expected performance. (See also W88-10912) (Cassar-PTT)
W88-10923

GROUND WATER HYDROLOGY AND WATER LAW: BRIDGING THE GAP WITH MODELS,
For primary bibliographic entry see Field 4B.
W88-10924

SOURCE TERM EQUATIONS AND SOLUTE TRANSPORT MODEL FOR CONSUMPTIVE USE PERMIT APPLICATION,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5B.
W88-10925

PREDICTION OF THE FATE OF CHROMIUM FROM A PROPOSED MUNICIPAL SANITARY LANDFILL,
Foth and Van Dyke and Associates, Inc., Green Bay, WI.
For primary bibliographic entry see Field 5B.
W88-10926

REMEDIAL INVESTIGATION AND DESIGN FOR A MINE-TAILINGS WASTEWATER FACILITY IN SOUTHWESTERN WYOMING,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5B.
W88-10927

ELIMINATING CONTAMINANT STAGNATION AREAS: A KEY TO OPTIMIZING GROUND WATER RECOVERY SYSTEM DESIGNS,
AWARE, Inc., West Milford, NJ.
For primary bibliographic entry see Field 5G.
W88-10928

FIELD APPLICATIONS OF MULTIPLE-AQUIFER, GROUND WATER MODELS FOR FLOW AND TRANSPORT TO UNDERGROUND COAL GASIFICATION SITES,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5B.
W88-10929

REPRESENTATION OF INDIVIDUAL WELLS IN TWO-DIMENSIONAL GROUND WATER MODELING,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
M. S. Beljin.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 340-351, 3 fig, 2 tab, 17 ref.

Descriptors: *Groundwater movement, *Wells, *Model studies, Mathematical models, Hydraulic profiles, Nodal correction, Simulation, Spatial distribution.

Since well-field simulation in groundwater modeling requires grid blocks with dimensions much larger than the well diameter, the computed hydraulic head for the well block (the block containing the well) represents an average hydraulic head and not the head in the particular well. The effect of an individual well is normally represented by an imposed discharge/recharge rate on the well block. A steady-state flow is assumed. The nodal correction is computed from the equivalent well block radius (defined as the radius at which the steady-state hydraulic head in the aquifer is equal to the numerically calculated head of the well block). This study investigated the effects of several well situations on the nodal correction: a well not positioned at the center of the well block, a rectangular well block with different aspect ratios, an aniosotropic medium, and more than one well within the block. Two approaches for computing the correct value of the head in the well are possible. The first uses an analytical expression for calculating the approximate nodal correction, the magnitude of which depends on the aquifer parameters and on the grid design. A library of analytical solutions for different field situations can be incorporated into a code. The second approach develops a localized refined mesh in the finite-difference grid. The radial nature of flow near the wells makes a hybrid approach most suitable. The entire domain is divided into a well region, represented with a cylindrical grid, and a model region represented with a rectangular grid. (See also W88-10912) (Cassar-PTT)
W88-10930

USE OF A MULTIGRID TECHNIQUE TO STUDY EFFECTS OF LIMITED SAMPLING OF HETEROGENEITY ON TRANSPORT PREDICTION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-10931

SIMPLE MODEL FOR TRANSPORT OF FREE-PHASE ORGANICS IN UNSATURATED ZONES OF AQUIFERS,
Colorado Univ., Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 5B.
W88-10933

VERIFICATION OF NUMERICAL MODELS: VARIABLY SATURATED FLOW THROUGH A HETEROGENEOUS MEDIA,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2G.
W88-10934

TREATMENT OF HETEROGENEITIES IN GROUND WATER FLOW MODELING,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
M. P. Anderson.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 444-463, 10 fig, 3 tab, 36 ref.

Descriptors: *Groundwater movement, *Heterogeneity, *Anisotropy, *Model studies, Mathematical models, Deltas, Eskers, Glacial drift, Hydraulic conductivity.

The effects of different scales of heterogeneity were explored by examining flow through a graded bed and flow through an esker delta. Each system was viewed under different flow regimes, and heterogeneity was viewed under different scales. Several conclusions were drawn: (1) For flow modeling, the scale at which heterogeneity is simulated should match the measurement scale used to obtain the field heads that serve as the calibration standard. (2) If sufficient geologic information is available, it is possible to calculate the ratio of horizontal to vertical hydraulic conductivity appropriate to the modeling scale prior to calibration attempts. (3) When a two-dimensional model is used to simulate a system influenced by an three-dimensional flow field, calibration may be biased by use of a calibrated anisotropy ratio that differs from the true anisotropy ratio for the system. (4) The sensitivity of a model to prepresentation of heterogeneity depends on the boundary conditions, making independent field measurement of flow rate essential. (5) Proper treatment of large-scale heterogeneity patterns and trends in the hydraulic conductivity distribution is critical to obtaining an accurate representation of the flow field and accurate flow estimates. (See also W88-10912) (Cassar-PTT)
W88-10935

ROLE OF LEAKAGE IN THE SEA WATER INTRUSION OF A CONFINED COASTAL AQUIFER,
Montgomery (James M.), Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 5B.
W88-10936

APPLICATION OF A GROUND WATER MODEL FOR MANAGEMENT OF SEA

WATER INTRUSION IN SALINAS VALLEY, CALIFORNIA,
Boyle Engineering Corp., Lakewood, CO.
For primary bibliographic entry see Field 5B.
W88-10937

THREE-DIMENSIONAL MODELING ANALYSIS OF GROUND WATER PUMPING SCHEMES FOR CONTAINMENT OF SHALLOW GROUND WATER CONTAMINATION,
Papadopulos (S.S.) and Associates, Inc., Rockville, MD.
For primary bibliographic entry see Field 5G.
W88-10938

MODELING THREE-DIMENSIONAL FLOW NEAR A PARTIALLY PENETRATING WELL IN A STRATIFIED AQUIFER,
Indiana Univ., Bloomington. School of Public and Environmental Affairs.
H. M. Haitjema.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 532-540, 4 fig, 5 ref.

Descriptors: *Model studies, *Partially penetrating wells, *Groundwater movement, *Wells, Stratified aquifers, Stratification, Mathematical models, Aquifers.

The analytical element method was used to model locally three-dimensional flow within an otherwise two-dimensional regional flow model. Aquifer stratification was incorporated, following the example of incorporating a partially penetrating well near a shallow creek. It was concluded that near a partially penetrating well, aquifer stratification can be handled efficiently by use of disc-shaped doublet panels (double layers) with a radially varying doublet density. (See also W88-10912) (Cassar-PTT)
W88-10939

USE OF THREE-DIMENSIONAL MODELING IN THE MANAGEMENT OF A GROUND WATER SYSTEM RELYING ON INDUCED RECHARGE,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
For primary bibliographic entry see Field 4B.
W88-10940

THREE-DIMENSIONAL FREE AND MOVING BOUNDARY SEEPAGE PROBLEMS SOLVED USING AN INTEGRAL TRANSFORMATION IN A FIXED DOMAIN METHOD,
California Univ., Santa Barbara.
J. C. Bruch.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 575-589, 2 fig, 28 ref.

Descriptors: *Groundwater management, *Dams, *Seepage loss, *Model studies, Mathematical models, Earth dams, Porous media, Unsteady flow, Algorithms.

Numerical solutions (both finite difference and finite element) to three-dimensional free and moving boundary seepage problems are presented. The flow configuration used is that of seepage through an earth dam with and without accretion and with and without a toe drain. The theoretical approach uses a Baiocchi-type transformation to generate a problem in a fixed known region obtained by an extension of the unknown solution region for the unsteady problem, while the Baiocchi transformation is used for steady-state problems. The steady or transient problem is then solved by an iterative method of successive over-relaxation type using either finite difference, finite element or a combination of these methods. The essentials of the approach along with the simple computational algorithm that results and some numerical results are given. This survey paper brings together work done to date on these three-dimensional problems by this technique. (See also W88-10912) (Author's abstract)
W88-10941

APPLICATION OF A QUASI-THREE-DIMENSIONAL FLOW MODEL,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 4B.
W88-10942

RELIABILITY ANALYSIS FOR GROUND WATER MODELS: AN APPROACH THROUGH USE OF CONFIDENCE AND PREDICTION INTERVALS,
Geological Survey, Denver, CO.
R. L. Cooley, and A. V. Vecchia.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 613-625, 5 fig, 10 ref.

Descriptors: *Reliability analysis, *Groundwater movement, *Model studies, Numerical analysis, Mathematical studies, Regression analysis, Prediction, Confidence intervals.

The reliability of groundwater models may be investigated by computing confidence intervals for model parameters and by computing confidence and prediction intervals for model output. These intervals are called reliability intervals. A reliability interval may be computed by using a general Lagrangian technique that determines extreme values of the variable in question subject to the constraint that the parameters lie in a joint confidence region with specified probability control. Three general classes of reliability intervals are considered: intervals based on observed or assumed information (called prior information) on model parameters, intervals based on manually calibrated models, and intervals based on nonlinear regression models. In the first case, the reliability intervals are based solely on hydrogeologically derived information on model parameters; information on observed hydraulic heads is not included. In the second case information on the model parameters is assumed to be improved compared to the prior information through the manual (trial and error) calibration process, which utilizes observed head and flux information. Since manual calibration is a subjective process, the computed reliability intervals should be compared to observed heads and fluxes to determine if the intervals are consistent with the observed data at the specified probability level. In the third case nonlinear regression is used to improve estimates of the model parameters. The nonlinear regression procedure reduces to generalized least squares for the problems considered, and both observed heads and prior information on parameters are utilized by the procedure. Reliability intervals computed can be based on the linearized, likelihood or exact types of joint confidence regions for the parameters. Reliability intervals based on either manual calibration or regression methods are an improvement on intervals based solely on prior information. However, reliability intervals based on regression methods are preferable because they are more accurate and less subjective than reliability intervals based on manual calibration. (See also W88-10912) (Author's abstract)
W88-10943

ADJOINT SENSITIVITY ANALYSIS FOR MASS TRANSPORT,
Conestoga-Rovers and Associates, Waterloo (Ontario).
For primary bibliographic entry see Field 5B.
W88-10944

METHODS FOR THE SIMULATION OF POLLUTANT TRANSPORT IN GROUND WATER: A MODEL COMPARISON,
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
For primary bibliographic entry see Field 5B.
W88-10945

COMPARISON OF INVERSE MODELING RESULTS WITH MEASURED AND INTERPOLATED HYDRAULIC HEAD DATA,
Battelle Pacific Northwest Labs., Richland, WA.
E. A. Jacobson.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 675-700, 18 fig, 1 tab, 17 ref. Dept. of Energy Contract DE-AC06-76RLO 1830.

Descriptors: *Groundwater movement, *Hydraulic head, *Model studies, Mathematical models, Aquifers, Transmissivity, Avra Valley, Arizona, Wells, Kriging, Inverse modeling, Interpolation.

Inverse modeling of aquifers involves identification of effective parameters, such as transmissivities, based on hydraulic head data. The result of inverse modeling is a calibrated groundwater flow model that reproduces the measured hydraulic head data as closely as is statistically possible. In addition to the calibrated model, inverse modeling yields estimation errors for the effective parameters. In most applications of inverse methods, hydraulic head data are not available over the entire study area. This deficiency has led some researchers to estimate hydraulic head values at node points where no data exist by interpolation techniques such as kriging or hand contouring. However, other researchers prefer to consider only hydraulic head values at well locations. An inverse method that includes prior information about the parameters (i.e., kriged log transmissivity) was applied to the Avra Valley aquifer of southern Arizona using hydraulic heads obtained in three ways: measured at well locations, estimated at nodes by hand contouring, and estimated at nodes by kriging. Hand contouring yielded only estimates of hydraulic head at node points, whereas kriging yielded hydraulic head estimates at node points and their corresponding estimation errors. A comparison of the three inverse applications indicates the variations in the groundwater flow model caused by the different treatments of the hydraulic head data. Estimates of hydraulic head computed by all three inverse models were more representative of the measured or interpolated hydraulic heads than those computed using the kriged estimates of log transmissivity. The large-scale trends in the estimates of log transmissivity determined by the three inverse models were generally similar except in the southern portion of the study area. The hydraulic head values and gradients produced by the three inverse models were similar in the interior of the study area, while the major differences between the inverse models occurred along the boundaries. (See also W88-10912) (Author's abstract)
W88-10946

REMEDIAL ACTIONS UNDER VARIABILITY OF HYDRAULIC CONDUCTIVITY,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 5G.
W88-10947

ANALYTICAL AND NUMERICAL SIMULATIONS OF LEACHATE MIGRATION IN UNCONFINED AQUIFERS,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-10948

SIMULATION OF GROUND WATER CONTAMINATION IN THREE DIMENSIONS,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5B.
W88-10949

WASTE CONFINEMENT PERFORMANCE OF DEEP INJECTION WELLS,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-10950

COMPUTER AIDED SITE INVESTIGATION AND MANAGEMENT: A TOOL FOR ASSESSING AND MANAGING GROUNDWATER CONTAMINATION,
Hydro Geo Chem, Inc., Tucson, AZ.
For primary bibliographic entry see Field 5G.
W88-10951

NEW SEISMIC-HYDRAULIC APPROACH TO MODELING FLOW IN FRACTURED ROCKS,
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
P. A. Witherspoon, J. C. S. Long, E. L. Majer, and L. R. Myer.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 793-826, 15 fig, 4 tab, 40 ref. Dept. of Energy Contract DE-AC03-76F00098.

Descriptors: *Groundwater movement, *Seismology, *Geologic fractures, *Fluid flow, *Model studies, Mathematical models, Rocks, Aquifers, Anisotropy, Geysers geothermal field, California, Rock properties, Geometric analysis.

Investigations to characterize the geometry of fractured rocks and to develop methods of handling fluid flow and transport through these systems are summarized. Numerical models were developed for two- and three-dimensional networks of fractures; these models can incorporate the vagaries of channel flow whenever necessary. Fracture length proved important in controlling flow and transport. When fracture length is small, it must be measured in order to predict permeability. As fracture length increases, permeability approaches a maximum value, and it may not be necessary to measure exactly. The effects on transport of aperture dispersion and the correlation between length and aperture were investigated. Results indicate that the effect on the transport parameters (permeability porosity, etc.) of an increase in the coefficient of variation of aperture is opposite to the effect of an increase in the correlation between length and aperture. Vertical seismic profiling was studied. Laboratory measurements showed a significant attenuation of shear waves as fracture stiffness decreased and frequency increased. An experiment in the Geysers geothermal field, California, where fracture orientation is known, produced shear wave splitting and velocity anisotropy in agreement with theory. This suggests the potential application of three-component, multi-source vertical seismic profiling data in determining fracture orientation and average spacing. (See also W88-10912) (Cassar-PTT)
W88-10952

MODELING STUDY OF THE CULEBRA DOLOMITE,
INTERA Technologies, Inc., Austin, TX.
A. Haug.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 827-852, 17 fig, 1 tab, 21 ref. Dept. of Energy Contract DE-AC04-76DP00789.

Descriptors: *Disposal wells, *Geohydrology, *Culebra Dolomite, *Groundwater movement, *New Mexico, *Model studies, Mathematical models, Dolomite, Rustler Formation, Aquifers, Waste Isolation Pilot Plant, Radioactive waste disposal, Waste disposal, Transmissivity, Hydraulic head, SWIFT II model, Pumping tests, Pilot plants, Spatial distribution.

A modeling study was performed as part of the regional hydrologic characterization of the Waste Isolation Pilot Plant site in New Mexico. The study resulted in an estimation of the transmissivity distribution, the hydraulic potentials, the flow field, and the fluid densities in the Culebra Dolomite Member of the Rustler Formation at the waste site. The work performed consisted of modeling the hydrogeology in the Culebra using two different approaches: (1) steady-state modeling of the best estimate of the undisturbed situation, and (2) transient modeling of the hydrogeologic conditions resulting from excavating three shafts at the center of the waste site as well as from various well tests. The three-dimensional finite-difference code SWIFT II with variable fluid density formulation was employed. The size of the model area was 12.24 km x 11.70 km. The boundary conditions (prescribed pressures and fluid densities) were estimated using the hydraulic head and fluid density data obtained from 40 wells at the waste site. The initial spatial transmissivity distribution in the Culebra dolomite was estimated using kriging techniques. The steady-state model was calibrated against the observed formation pressures and fluid densities. The calibration parameters were the transmissivities and the boundary conditions. The transmissivities were modified during the calibration process using kriging techniques, thus maintaining the statistical properties of the observed transmissivity data. The calibrated steady-state model was used as initial conditions for simulating transient processes in the Culebra at the waste site. The examples presented include the shaft history beginning in 1981 and a long-term pumping test (denoted the H-3 multipad pumping test) conducted in 1985. (See also W88-10912) (Author's abstract)
W88-10953

COMBINED MODELING PROGRAM FOR EVALUATING THE COVER DESIGN AT A URANIUM MILL TAILINGS DISPOSAL SITE,
Colorado Geological Survey, Denver.
For primary bibliographic entry see Field 5E.
W88-10954

MODELING OF GROUND WATER FLOW THROUGH A WP-CAVE,
Uppsala Geosystem A.B. (Sweden).
For primary bibliographic entry see Field 5E.
W88-10955

MODELING AREAL, VARIABLE-DENSITY, GROUND-WATER FLOW USING EQUIVALENT FRESHWATER HEAD: ANALYSIS OF POTENTIALLY SIGNIFICANT ERRORS,
Geological Survey, Albuquerque, NM.
P. B. Davies.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 888-903, 7 fig, 14 ref.

Descriptors: *Radioactive waste disposal, *Gravity effects, *Simulation, *Groundwater movement, *Model studies, Mathematical models, Waste Isolation Pilot Plant, New Mexico, Spatial variation, Fluid density, Gravity groundwater, Aquifers, Waste disposal, Equivalent freshwater head, Pilot plants, Dolomite, Nomographs.

An analysis of the relative magnitude of density-related gravity effects was made as part of a regional study of the groundwater flow system in a gently dipping dolomite aquifer in the vicinity of the Waste Isolation Pilot Plant, New Mexico. A comparison of equivalent freshwater-head simulations with variable-density simulations showed an area along the flow path leaving the site where equivalent freshwater-head simulations produced errors in predicted flow direction of up to 170 degrees and underestimated predicted velocity magnitudes by as much as a factor of 10. A nomograph is presented for identifying situations where density-related gravity effects exert a significant influence on a given flow system and where groundwater flow models based on equivalent freshwater heads may produce large errors in predicted flow direction and magnitude. The nomograph plots the driving force ratio as a function of elevation gradient/equivalent freshwater-head gradient for a family of fluid density curves, ranging from brackish to brine that is saturated with respect to NaCl. At a driving force ratio of 0.5, the density-related gravity effects may become significant. (See also W88-10912) (Cassar-PTT)
W88-10956

APPLICATION OF STOCHASTIC GROUND WATER MODELS TO GEOLOGIC DISPOSAL OF HIGH-LEVEL NUCLEAR WASTE,
Rockwell International, Richland, WA. Rockwell Hanford Operations.
For primary bibliographic entry see Field 5E.
W88-10957

ANALYTIC ELEMENT METHOD FOR REGIONAL GROUNDWATER MODELING,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
O. D. L. Strack.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 929-941, 9 fig, 16 ref.

Descriptors: *Groundwater movement, *Analytic element method, *Model studies, Mathematical equations, Heterogeneity, Mathematical models, Aquifers, Rivers, Lakes, Wells, Infiltration, Streams, Leakage, Rainfall, Hydraulic conductivity, Dupuit-Forchheimer theory, Computer programs.

This paper presents an overview of the analytic element method as applied to problems of regional groundwater flow using the DuPuit-Forchheimer assumption. This method is based on the superposition of analytic functions, each representing a particular aquifer feature or a part thereof. Aquifer features include uniform flow, uniform rainfall infiltration, infiltration over a circular area, wells, creeks, rivers, lakes, isolated narrow drains and creeks, narrow leaky walls, and inhomogeneities. A system of equations is set up for the determination of the parameters in the problem. Examples are given in the form of plots of piezometric contours obtained from a computer program in which the analytic element method is implemented. (See also W88-10912) (Cassar-PTT)
W88-10958

MODELING DISPERSION IN LAYERED AQUIFERS USING THE DUPUIT-FORCHHEIMER ASSUMPTION,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
W. J. Zaadnoorkijk, and O. D. L. Strack.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 945-953, 12 fig, 10 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *Groundwater pollution, *Layered aquifers, *Model studies, Mathematical models, Aquifers, Dupuit-Forchheimer theory, Solute transport, Hydraulic conductivity, Ponds, SLAEM model, Infiltration.

A deterministic approach is suggested for modeling the effect of layering in aquifers on contaminant transport. Layers with different hydraulic conductivities cause longitudinal dispersion over the thickness of the aquifer. The equations for including the layers in Dupuit-Forchheimer models and the equations for computing points on path lines and streamlines in three dimensions are given. As an example, results are presented from modeling a circular pond with constant infiltration into an unconfined aquifer with a uniform far-field. Two cases are distinct: with a stagnation point and without a stagnation point. (See also W88-10912) (Cassar-PTT)
W88-10959

ANALYSIS OF THE VALIDITY OF ANALYTICAL MODELS USED FOR ASSESSMENT OF FORTY-FIVE WASTE SITE AREAS: SUBSURFACE FLOW AND CHEMICAL TRANSPORT,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5B.
W88-10960

SEMI-ANALYTICAL METHOD FOR CONTAMINANT TRANSPORT MODELLING,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.

For primary bibliographic entry see Field 5B.
W88-10961

PREDICTING FUTURE GROUND WATER LEVELS WITH CONFIDENCE,
Brown and Caldwell, Atlanta, GA.
For primary bibliographic entry see Field 4B.
W88-10962

METHODOLOGY AND USE OF INTERFACING REGIONAL AND SUBREGIONAL GROUND WATER FLOW MODELS,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 4B.
W88-10963

ROLE OF A MULTILAYER MODEL IN REFINING UNDERSTANDING OF DEEP REGIONAL GROUND-WATER FLOW IN A TECTONICALLY ACTIVE AREA,
Geological Survey, Nashville, TN.
J. V. Brahana.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1051-1070, 9 fig, 1 tab, 35 ref.

Descriptors: *Groundwater movement, *Tectonics, *Model studies, Mathematical models, McDonald-Harbaugh model, Aquifers, Mississippi Embayment, McNairy-Nacatoch aquifer, Leakage, Hydraulic conductivity, Recharge, Hydrologic budget.

A study of the Upper Cretaceous aquifer in the northern Mississippi embayment indicated that a multilayer model was a valuable tool that provided a relatively rapid yet powerful evaluation of alternative boundaries (discharge) of an aquifer that was poorly defined by sparse data. The area is tectonically active and discharge originally was suspected to be concentrated along the subcrop of the aquifer with the overlying alluvium. The model simulation suggested high leakage occurred in an area overlying a deeply buried rift boundary. The model provided a quantitative assessment of the hydrologic budget of the aquifers for each boundary condition simulated. The major components of recharge to the Upper Cretaceous aquifer were (1) precipitation on the outcrop (85 cu ft/s or 0.3 inch); (2) upward leakage from the subcrop of the Ozark-St. Francois aquifer (15 cu ft/s); and (3) upward leakage from the Ozark-St. Francois aquifer at the rift boundary (3 ft/s). Major components of discharge were calculated as upward leakage through the Midway confining unit in the vicinity of the rift (50 cu ft/s), diffuse upward leakage through the Midway throughout the rest of the Mississippi embayment (3 cu ft/s), upward leakage at the subcrop (alluvium) (16 cu ft/s), and pumping (35 cu ft/s). With the exception of the discharge zones, the Midway confining unit is a hydraulically tight confining layer for the aquifer throughout the northern Mississippi embayment. Discharge from the Upper Cretaceous to overlying aquifers generally is less than 50 cu ft/s at the discharge areas, with flow directions from the underlying to the overlying aquifers. Improved understanding of the flow system aided by model simulations identified areas where additional data would be most valuable. In the case of the Upper Cretaceous aquifer, the areas were located between the western margin of the Mississippi embayment rift and the subcrop with the alluvium. In general, additional data points are most valuable near undocumented but suspected boundaries, near areas where water-level gradients change rapidly, and areas where only a few existing data points are available for judging the simulated results. (See also W88-10912) (Author's abstract)
W88-10965

WHERE'S THE RETURN KEY,
Oklahoma State Univ., Stillwater. Dept. of Geology.
W. A. Pettyjohn.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1073-1083, 5 fig, 3 ref.

Descriptors: *Model studies, *Groundwater level, *Water level, Field studies, Computers, Mathematical studies, Wells, Oklahoma, Suburban areas.

The computer program developer is contrasted with the user, between the theoretical and the practical, and between model users and model nonusers who do not know where the return key on the computer is located. The author stresses a return to the fundamentals with the intent to revise or strengthen the understanding of the subsurface and how it reacts naturally and to stress. This also implies a return to field studies and the development of an adequate data base. Results of an 18-month study on groundwater level in a suburban backyard in Oklahoma showed great variability in water quality, permeability, recharge rates, well yields, etc. A stochastic approach, one that allows input of a range of values, is suggested. (See also W88-10912) (Cassar-PTT)
W88-10966

GRID REFINEMENT APPROACH TO FLOW AND TRANSPORT MODELING OF A PROPOSED GROUND-WATER CORRECTIVE ACTION AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-10967

FORT HUACHUCA GROUND WATER MODELING STUDY,
Army Engineer District, Los Angeles, CA.
For primary bibliographic entry see Field 4B.
W88-10968

AUTOMATED GIS FOR GROUND WATER CONTAMINATION INVESTIGATION,
Environmental Systems Research Inst., Redlands, CA.
For primary bibliographic entry see Field 5B.
W88-10969

DETERMINATION OF MEAN TRANSMISSIVITY VALUES IN THE MODELING OF GROUND WATER FLOW,
South Dakota School of Mines and Technology, Rapid City. Dept. of Geology and Geological Engineering.
A. D. Davis.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1162-1174, 6 fig, 9 ref.

Descriptors: *Groundwater movement, *Transmissivity, *Heterogeneity, Model studies, Mathematical models, Alluvial aquifers, Aquifers, Solute transport, Mapping, Unconfined aquifers, Permeability, Wells.

Numerical modeling showed that the weighted geometric mean is an accurate method of obtaining representative transmissivity values for a heterogeneous, permeable medium when heterogeneities are distributed randomly or nearly so and when transmissivity contrasts are less than about 25:1. In a field application to an unconfined alluvial aquifer, the weighted geometric mean was helpful for obtaining mean transmissivity values during the verification of a model. Initial values of transmissivity were estimated from slug tests and an aquifer test. Based on the slug tests, different transmissivity values were assigned to stream-channel deposits, point-bar deposits, and interchannel regions. The areas of each type of deposit within a cell were calculated from a map of abandoned stream channels, drawn from aerial photographs and field mapping. The weighted geometric mean then was used to determine representative transmissivity values for each cell of the model. A satisfactory match to the pumping test's drawdown and recovery was achieved quickly and easily with the model. The use of the weighted geometric mean, together with geologic information, provides a rationale for assigning transmissivity values to cells of a model, as an alternative to less systematic verification procedures. (See also W88-10912) (Cassar-PTT)
W88-10970

EVALUATION OF PRESSURE RELIEF WELL SYSTEM PERFORMANCE USING A NUMERICAL GROUND WATER FLOW MODEL,
Woodward-Clyde Consultants, Overland Park, KS.
For primary bibliographic entry see Field 4B.
W88-10971

APPLIED GROUND WATER MANAGEMENT MODEL FOR EVALUATING WATER CONSERVATION THROUGH REDUCING PHREATOPHYTE TRANSPIRATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 3B.
W88-10972

TWO DIMENSIONAL MODELING APPROACH OF A MIXTURE OF COMPOUNDS FOR THE ASSESSMENT OF HUMAN AND ENVIRONMENTAL HEALTH IMPACTS,
Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5B.
W88-10973

MODULAR FINITE-ELEMENT MODEL FOR SOLVING GROUND WATER FLOW PROBLEMS IN TWO DIMENSIONS,
Geological Survey, Doraville, GA.
L. J. Torak.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1231-1261, 11 fig, 11 ref.

Descriptors: *Groundwater movement, *Model studies, *Mathematical models, *Finite element method, MODFE model, Anisotropy, Aquifers, Heterogeneity, Storage, Leakage, Confined aquifers, Computer models, Galerkin method.

Modular Finite-Element Model (MODFE) is a digital-computer program that solves equations of groundwater flow in two dimensions by use of the Galerkin finite-element method with triangular elements and linear coordinate functions in space and time. Some of the aspects of MODFE that make it a unique and powerful tool are (1) MODFE can simulate nonhomogeneous and anisotropic flow problems where the directions of anisotropy change within the model region; (2) portions of the aquifer region can dewater and then resaturate during simulation; and (3) partial or complete drying of elements is permitted. Vertical leakage with the effects of water stored in a confining bed is simulated for confining beds that have laterally heterogeneous and elastic properties. MODFE simulates changing storage properties in an aquifer (from confined-to-unconfined conditions and vice versa) and nonlinear-leakage functions (for line, point, or areally distributed sources or sinks) by use of a Galerkin-in-time approach with coordinate functions that weight the appropriate leakage expressions proportionately over the time step. Transmissivity terms are updated efficiently for water-table simulations by using average values of saturated thickness along an element side; this eliminates recomputing the entire transmissivity matrix on each time step. Matrix equations are solved either by a direct method of triangular decomposition or by an iteration method that uses a modified incomplete-Cholesky conjugate-gradient method. MODFE can be readily adapted for use on personal computers. The modular-program assembly allows the user to create a unique version of MODFE that contains only the simulation capabilities necessary for solving the aquifer problems of interest. (See also W88-10912) (Cassar-PTT)
W88-10974

APPLICATION OF SENSITIVITY AND SECOND ORDER UNCERTAINTY ANALYSIS

IN FORMULATING REGIONAL GROUNDWATER CONTAMINATION RISKS AND DATA SENSITIVITIES,
Kirkner and Associates, Inc., Lake Wales, FL.
For primary bibliographic entry see Field 5B.
W88-10975

MODELING MICROBIAL FOULING IN POROUS MEDIA,
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
A. B. Cunningham, W. G. Characklis, A. Escher, and D. Crawford.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1289-1314, 13 fig, 22 ref. U.S. Geological Survey Grant 14-08-0001-01284, Office of Naval Research Grant N000014-84-K-0309, Grant CTB-8420785.

Descriptors: *Water treatment, *Wastewater treatment, *Porous media, *Fouling, *Model studies, Hydraulic resistance, Mathematical models, Accumulation, Bioaccumulation, Biological wastewater treatment, Growth, Biofilms, Groundwater movement, Microorganisms.

An overview of biofilm formation and effects in porous media is presented. A biofilm consists of microbial cells and their products which attach to an inanimate surface submerged in an aquatic environment. Thickness varies from a monolayer to 300-400 mm thick as in an algal mat. Aerobic and anaerobic environments exist within the biofilm. As many as five phases can be defined in a biofilm system: substratum, base film, surface film, liquid, gas. Interaction between phases occurs via transport processes such as liquid transport, molecular diffusion, volumetric displacement, cell motility, and macroorganism grazing. Biofilms extract contaminants from water in various porous media environments. This absorption takes place in groundwater systems and in porous and granular media used in water treatment and wastewater treatment. Biofilms significantly influence hydraulic resistance in porous media such as aquifers, and they can retard recharge from a stream bottom as a result of their accumulation on a stream bottom. The long-range goal of research in biofilm processes is the identification of relevant parameters and quantification of their influence on the rate and extent of microbial cell adsorption, desorption, and growth in surfaces in porous media. Biofilm accumulation takes place in three arbitrarily determined periods: induction, logarithmic accumulation, and steady state. A new class of models offers the possibility of investigating fouling/corrosion prevention and control at a new and more detailed level of mechanisms. (See also W88-10912) (Cassar-PTT)
W88-10976

MEASURING HYDRAULIC CONDUCTIVITY OF SEDIMENTS IN A RIVER WITH A FLUCTUATING LEVEL,
Bostock Engineering Services, Toronto (Ontario).
C. A. Bostock, and G. Westerby.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1315-1331, 6 fig, 2 tab, 6 ref.

Descriptors: *Surface-groundwater relations, *Groundwater movement, *Rivers, *Hydraulic conductivity, *Model studies, Sediments, Mathematical models, Water level fluctuations, Fluctuations, Seepage, Dams, Embankments, Specific yield, Wells, Particle size.

A method and computer model enabled measurement of the bulk hydraulic conductivity of deep sediments underlying a river for the construction of an embankment dam and its upstream impermeable blanket. A hydraulically emplaced sand pad, enclosed by a rock and rubble wall, extended halfway across the river channel. Fluctuations of the river level caused by an upstream dam induced seepage back and forth between the river and the water table in the sand pad. The method required first, recording hydrographs from a stilling well in the river and one or more piezometers installed in the river sediments; second, measuring the specific yield of the sediments in the sand pad; and third, defining the flow system geometry. The specific yield determined the flux in the model as the model responds to the stilling well hydrograph. The model was calibrated by varying the hydraulic conductivity of the sediments over a range of values, to obtain the minimum sum of squares of the differences between the field hydrographs and the model hydrographs over a given data period. The minimum sum for each piezometer indicated a bulk hydraulic conductivity value as seen from each piezometer. Accuracy in the described application required attention to the following: the flow system geometry and its representation in the model, the delayed yield, the capillary forces, the settlement of elevation reference points caused by sediment compaction work on the sand pad, the avoidance of interfering effects from hydraulic work and the removal of human error in recording and key punching the hydrograph data. The hydraulic conductivity values obtained from this application correlated well with those obtained from grain size distributions of samples from the river sediments. (See also W88-10912) (Author's abstract)
W88-10977

DRAINMOD: A WATER TABLE MANAGEMENT SIMULATION MODEL,
Ohio Agricultural Research and Development Center, Wooster. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W88-10978

USE OF PC SPREADSHEET MODELS AS A ROUTINE ANALYTICAL TOOL FOR SOLVING GROUND WATER PROBLEMS,
Highland Associates, Golden, CO.
W. R. Highland.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1345-1352, 4 fig, 3 tab, 6 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Model studies, *Computer models, Mathematical models, Solute transport, Finite difference methods, Aquifers, Infiltration, Fluid flow, Multiphase flow, Spreadsheet models, Personal computers.

A personal computer with spreadsheet software provides an intermediate level of analysis for groundwater problems, avoiding the crude approximations obtained from the simple analytical solutions and the more accurate but time-consuming and expensive numerical models. Spreadsheet models can be constructed and used to solve a wide variety of groundwater problems without detailed knowledge of matrix solution techniques. Linear and nonlinear problems can be solved with equal ease. Two examples are given: (1) unconfined flow with infiltration, and (2) two-fluid flow with a dense fluid and a light fluid as are often found in organic contamination of an aquifer. (See also W88-10912) (Cassar-PTT)
W88-10979

GEOCHEMICAL REACTION MODELING IN CONTAMINANT MIGRATION STUDIES OF THE URANIUM MILL TAILINGS ENVIRONMENT,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-10980

USE OF THE VERTICAL HORIZONTAL SPREAD (VHS) MODEL FOR DELISTING HAZARDOUS WASTE,
Minnesota Mining and Mfg. Co., St. Paul.
For primary bibliographic entry see Field 5B.
W88-10981

MODELING SORBING SOLUTE TRANSPORT THROUGH HETEROGENEOUS AQUIFERS ON A SUPERCOMPUTER,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-10982

DEVELOPMENT OF A STRUCTURED MODEL OF MICROBIAL REACTION IN GROUND WATER CONTAMINATION PROBLEMS,
Kyoto Univ. (Japan).
For primary bibliographic entry see Field 5B.
W88-10983

GROUND WATER FLOW MODELING AT A HAZARDOUS WASTE SITE FOR REGULATOR COMPLIANCE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-10984

LINKED STREAM-AQUIFER SYSTEM MODEL,
Dames and Moore, Golden, CO.
For primary bibliographic entry see Field 2A.
W88-10985

APPLICATION AND DEMONSTRATION OF ANALYTIC ELEMENT MODELS,
Minnesota Univ., Minneapolis.
O. D. L. Strack, C. R. Fitts, and W. J. Zaadnoordijk.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1464-1474, 11 fig, 8 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Solute transport, *Model studies, *Analytic element method, Dupuit-Forchheimer theory, Computer models, SLWL model, SLAEM model, Aquifers, Grey Cloud Island, Minnesota, Unconfined aquifers, Rivers, Wells, Leachates, Waste disposal, Lagoons, Model studies, Mathematical models, Pulp and paper industry.

Two analytic element models were demonstrated in field applications. The SLWL program applies to steady flow in a single aquifer consisting of layers of hydraulic conductivities that are somewhat different; it contains functions for uniform flow, uniform infiltration from rainfall, circular area-sinks (ponds), wells, and line-sinks. It is suitable for initial modeling of regional flow but cannot be used for simulating of areas of different hydraulic conductivity, leakage through river and lake bottoms, and leaky walls or cracks. The SLAEM (Single Layer Analytic Element Model) program is the most comprehensive analytic element model available to the public. It is designed primarily for modeling steady-state conditions. The SLAEM was applied to the Grey Cloud Island system, an island in the Mississippi River near St. Paul, Minnesota. Here, two rather homogeneous aquifers act as a single hydraulic unit. The object of the model study was to determine the impact of the aquifer system of lowering the bottom of a quarry on the island. The quarry pumps much more water than the total amount of infiltration from rainfall; possible sources are the river or recharge areas on the other side of the rivers bounding the island. Contour maps generated from the program showed that lowering the quarry bottom would require pumping of about twice the amount of water. It was also confirmed that the quarry drains water from the Mississippi. A second field study was contaminant transport from paper mill lagoons in Fitchburg, Massachusetts. Underlying the site is an unconfined glacial outwash aquifer in which the leachate moves laterally. Visible contamination in the form of iron oxide staining was observed in the seepage areas to the east and north of the lagoons within the predicted limits of contamination, but not outside these limits. (See also W88-10912) (Cassar-PTT)
W88-10986

NEW ANNOTATION DATABASE FOR GROUND WATER MODELS,

Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 4B.
W88-10987

SOFTWARE PACKAGE OF GROUND WATER MODELING AND ITS APPLICATIONS,
Shandong Univ., Jinan (China).
J.-Y. Wang, N.-Z. Sun, W.-K. Liang, C.-M. Zhang, and X.-X. Meng.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1496-1500, 7 ref.

Descriptors: *Computer programs, *Groundwater movement, *Model studies, *Mathematical models, Unconfined aquifers, Multiple Cell Balance Method, Graphical analysis.

A new software package for groundwater modeling, which can be used to simulate two- or three-dimensional groundwater flow in confined and unconfined aquifers is introduced. The governing equations are discretized by the Multiple Cell Balance Method. The resulting equations are solved by a direct method in the two-dimensional case or by a modified iteration method in the three-dimensional case. Data can be input by graphic devices, and the results can be output by a graphic terminal or plotter. The program is also convenient for solving inverse problems. Either the trial-and-error method or an optimization procedure can be selected from a menu. (See also W88-10912) (Cassar-PTT)
W88-10988

BOUNDARY INTEGRAL-EQUATION-METHOD MODELING OF A REGIONAL AQUIFER USING GEOSTATISTICS,
Geological Survey, Denver, CO.
E. Weiss.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1501-1522, 8 fig, 2 tab, 15 ref.

Descriptors: *Groundwater movement, *Colorado River Basin, *Model studies, Mathematical models, Statistics, Geohydrology, Permeability, Hydraulic head, Aquifers, BIEM model.

A simple boundary integral-equation-method model was used to describe a regional aquifer, the Paleozoic groundwater aquifer system that includes part of the Upper and Lower Colorado River Basins. The assumptions and results of the model were used to characterize the regional flow system. Geostatistics were used to estimate the predictive capability of the model. The model had no interaquifer flow, no variation in transmissivity, and no adjustments were made in model parameters. Stream channels near the center of the study area simulated most of the discharge from the aquifer. The model could estimate hydraulic-head values as well as additional drill-stem-test measurements because the mean-square model error was less than the mean-square measurement error. A theoretical semivariogram based on hydraulic-head measurements provided the mean-square measurement error. The principal features of this regional picture were (1) no interaquifer flow, (2) a no-flow boundary along the Uncompahgre uplift, (3) most groundwater discharge from the upper Paleozoic aquifer occurs at the stream channels in the center of the study area, and (4) transmissivity is uniform. These features are approximate for the regional system and do not necessarily apply to specific localities. (See also W88-10912) (Cassar-PTT)
W88-10989

GRAPHICAL WELL ANALYSIS PACKAGE: A GRAPHICAL COMPUTER-ASSISTED CURVE MATCHING APPROACH TO WELL TEST ANALYSIS,
Groundwater Graphics, San Diego, CA.
D. A. Dansby.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1523-1534, 5 fig, 2 tab, 10 ref.

Descriptors: *Graphical analysis, *Computer programs, *Groundwater, *Wells, Model studies, Mathematical models, Graphical Well Analysis Package, Aquifers, Pumping tests, Graphical analysis.

The Graphical Well Analysis Package provides a more efficient method of performing the standard graphical curve matching technique in well test analysis. Data from the well test are plotted on the computer screen and then a type curve is selected, overlain, and matched to the data directly on the screen. The program supports confined-leaky aquifer, unconfined aquifer, large diameter well, and slug injection/withdrawal type curves. Use of this analysis package is faster, easier, and can be more accurate than the same method done manually. Among the problems of well test analysis that have been overcome include inability to recognize boundary conditions, inadequate visual means of checking the solution, inability to handle complicated aquifer/aquitard test situations, and lack of solutions for large diameter well tests and slug injection/withdrawal type curves. (See also W88-10912) (Cassar-PTT)
W88-10990

PROCEEDINGS OF THE NWWA FOCUS CONFERENCE ON MIDWESTERN GROUND WATER ISSUES.
Indianapolis, Indiana. April 21-23, 1987. National Water Well Association, Dublin, OH. 1987. 612 p.

Descriptors: *Groundwater, *Conferences, *Groundwater management, Path of pollutants, Computer programs, Cleanup operations, Underground waste disposal.

At this NWWA FOCUS Conference, government officials, consulting engineers, hydrogeologists, geologists, researchers, industry representatives, and other interested persons met to learn and to discuss midwestern groundwater issues. The conference provided a forum for all who attended to communicate and share their experiences in the rapidly-developing groundwater industry. A number of regional groundwater experts participated as invited speakers to share their knowledge on pertinent issues. Submitted and invited papers covered the following midwestern groundwater topics: midwestern groundwater management, glacial geology and groundwater, investigative techniques in groundwater, investigative techniques in the unsaturated zones, computer applications in groundwater, groundwater monitoring and aquifer restoration, and underground injection of waste. These proceedings are a compilation of papers presented by the symposium speakers. (See W88-11032 thru W88-11066) (Author's abstract)
W88-11031

GROUND WATER MANAGEMENT IN NORTHEASTERN ILLINOIS: UPCONING OF MINERALIZED WATER IN THE MT. SIMON FORMATION,
Environmental Protection Agency, Chicago, IL. Region V.
M. J. Barnes.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 93-116, 11 fig, 38 ref.

Descriptors: *Illinois, *Upconing, *Groundwater movement, *Saline water intrusion, *Model studies, Groundwater management, *Upconing, Mineral water, Geologic formations, Potable water, Water table decline, Water quality, Dissolved solids, Model studies, Groundwater movement, Pumpage, Simulation.

The deepest strata in northeastern Illinois, the Mt. Simon, contain mineralized water in all but the top 300 feet of the formation, which is a source of potable water. Pumpage from the overlying Cambro-Ordovician aquifer has caused a decrease in the piezometric surface exceeding 900 feet. This suggests that upconing of the mineralized water might occur, threatening the quality of a major groundwater-supply system for northeastern Illinois. Evidence for upconing is provided by chemical analyses of water samples, increases in the total dissolved solids of water pumped, and a coarse calculation for upconing. A vertical, two-dimensional, finite-difference groundwater-flow model was written to study the flow system and the upconing of the mineralized water. From model simulations, it was determined that the natural flow system of the Mt. Simon consists of a large recharge area to the northwest of the study area, a smaller discharge area to the southeast, and very slow flow in all but the upper 150 feet (50 m) of the formation. The upconing presented in the model would account for an increase in total dissolved solids as a function of time and increased pumpage from the system. (See also W88-11031) (Author's abstract)
W88-11038

USE OF FACIES MODELS AS PREDICTIVE TOOLS TO LOCATE AND CHARACTERIZE AQUIFERS IN GLACIAL TERRAINS,
Indiana Geological Survey, Bloomington.
G. S. Fraser, and N. K. Bleuer.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 123-143, 11 fig, 29 ref.

Descriptors: *Stratigraphy, *Facies models, *Groundwater, *Geohydrology, *Glacial aquifers, *Glacial drift, Terrain analysis, Model studies, Prediction, Exploration, Indiana, Sedimentary structures, Outwash, Geomorphology, Topography, Deposition, Glaciers, Glacial streams, Drilling, Drillers logs, Seismology, Aquifer characteristics.

Application of facies models to glacigenic terrains offers some potential for a more rational approach to locating the groundwater resources that they may contain and characterizing the materials of which they are composed. An ongoing program at the Indiana Geological Survey has used abundant subsurface information derived from driller's logs, seismic surveys, and an in-house drilling program to define the basic models that can be used to locate and characterize aquifers in most of the glacigenic terrains of the state. Outwash fans, valley-train deposits, and kamic or ice-contact deposits are all excellent sources of groundwater and all can be readily located on the basis of their geomorphic expression. Exploration for groundwater in terrains containing these types of deposits can be facilitated by analysis of the landsystem in which they occur and an interpretation of the depositional processes active during their formation. Buried aquifers, such as those that were covered by later glacial deposits or that were deposited at the base of temperate glaciers may not be so readily located because there is no surface expression of their presence. For these deposits, a more complete knowledge of the glacial history of the area, determination of ice-flow directions, and drainage directions, and analysis of the potential influence of substrate topography on glacial drainage patterns may be required before an actualistic model of the deposits can be made. (See also W88-11031) (Shidler-PTT)
W88-11040

HYDROGEOLOGICAL EVALUATION OF GROUNDWATER RESOURCES IN BURIED BEDROCK VALLEYS, NORTHEASTERN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
R. H. Gilkeson, S. S. McFadden, D. E. Laymon, and A. P. Visocky.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 145-167, 12 fig, 12 ref.

Descriptors: *Groundwater, *Geohydrology, *Geologic formations, *Bedrock, *Valleys, Evaluation, Illinois, Water resources developement, Pumping, Water quality, Water transport, Dolomite, Glacial drift, Geophysics, Borehole geophysics, Test holes, Wells, Cross-sections, Well logs, Aquifers, Field tests, Aquifer characteristics,

Leaky aquifers, Confined Aquifers, Impervious boundaries, Leakage, Water supply, Groundwater recharge, Municipal water, Water yield.

A comprehensive shallow groundwater resources-evaluation program is being conducted because of (1) increasing demand for water; (2) overpumping and natural water-quality problems (radium, barium, and salinity) in deep bedrock aquifers, the present major source of water; and (3) the high cost of transporting water from Lake Michigan. The shallow bedrock in the region is Silurian dolomite and dolomite and shale in the Ordovician Moquoketa Group. The bedrock is overlain by glacial deposits, which contain significant environments for shallow groundwater resources in buried bedrock valleys. The program uses a rigorous application of surface geophysics to guide the location of test borings and production wells. Cross sections of the drift-filled buried bedrock valleys, prepared using well records and surface and borehole geophysics for correlation, assist in the design and interpretation of aquifer tests. Several aquifer tests have been conducted to date in three different buried bedrock valley settings. Design and interpretation of the tests are complicated by complex aquifer geometry and areal variation in lithology. Generally, the tests show response typical of leaky, confined aquifers, although conditions may change to unconfined in the latter stages of the tests. Although impermeable boundaries were expected to appear in the results, they were not typically seen. Leakage vertically downward through the layered glacial drift and upward from the fractured bedrock, which is itself an aquifer for domestic wells and small public/industrial supplies, result in these units appearing as recharge boundaries on tests of short duration. It is believed that these conditions are favorable for development of the resource for public supply, with the glacial sand and gravel providing the transmissivity necessary for municipal well production and the fractured bedrock providing an adequate volume of water for safe long-term yields. (See also W88-11031) (Author's abstract)
W88-11041

WATER AND TRITIUM MOVEMENT IN VARIABLY SATURATED GLACIAL DEPOSITS NEAR SHEFFIELD, ILLINOIS,
Geological Survey, Urbana, IL.
P. C. Mills, and R. W. Healy.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 169-186, 8 fig, 15 ref.

Descriptors: *Illinois, *Radioactive waste disposal, *Path of pollutants, *Groundwater movement, *Radioisotopes, *Tritium, *Glacial drift, Saturation, Groundwater recharge, Trenches, Tunnels, Measuring instruments, Lysimeters, Tensiometers, Piezometers, Hydraulic conductivity, Hydrologic budget, Precipitation, Surface drainage, Permeability, Percolation, Shales, Sediments, Spatial distribution, Temporal distribution, Computer models, Simulation, Groundwater, Glacial aquifers.

The movement of tritium and other radionuclides in groundwater was monitored at a low-level radioactive-waste disposal site from 1981 to 1985. Groundwater movement through the variably-saturated deposits below the disposal trenches was generally restricted to a single annual spring recharge event. Tritium, the only radionuclide detected above background levels (200 picocuries per liter), ranged up to 10,000,000 picocuries per liter. Disposal trenches were constructed in complexly-layered glacial deposits that average 17 meters in thickness and overlie shale of Pennsylvanian age. A 120-meter-long tunnel provided access for instrumentation of the variably-saturated deposits below four of the trenches. Subtrench geologic materials were instrumented with lysimeters, tensiometers, and piezometers. Measurements of the horizontal saturated hydraulic conductivity of the clayey-silt- to sand-sized sediments ranged from 5.5 x 10 to the minus 9th power to 0.000054 meters per second, respectively. An estimated 118-millimeter average annual recharge to the unsaturated/saturated zone (undifferentiated) was determined by the water-budget method. Average annual precipitation was 875 millimeters. Groundwater flux from the trench covers to the saturated zone was estimated to be as high as 0.34 meters per day. Trench-cover-collapse holes provided preferential pathways for surface drainage into the trenches. Groundwater and tritium movement below the trenches varied spatially and temporally. Groundwater moved along sloping interfaces between geologic deposits of contrasting permeability, where downward percolation was impeded. Groundwater-flow paths were inferred from computer simulation by a variably-saturated flow model. (See also W88-11031) (Author's abstract)
W88-11042

ELECTRICAL RESISTIVITY APPLICATIONS TO GLACIAL AND GROUNDWATER SITE EVALUATIONS IN EAST-CENTRAL INDIANA,
Ball State Univ., Muncie, IN.
For primary bibliographic entry see Field 7B.
W88-11044

ESTIMATING FRACTURE CONNECTIVITY USING MEASUREMENTS OF BOREHOLE TEMPERATURES DURING PUMPING,
Notre Dame Univ., IN. Dept. of Civil Engineering.
S. Silliman, J. Nicholas, and A. Shapiro.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 231-248, 8 fig, 7 ref.

Descriptors: *Groundwater movement, *Geologic fractures, *Aquifer characteristics, *Boreholes, *Water temperature, *Pumping, Illinois, Observation wells, Dolomite, Hydraulic properties, Data interpretation, Flow pattern, Field tests, Design criteria.

Field tests were used to identify fracture interconnectivity in a dolomitic aquifer in northeastern Illinois. Temperature measurements in an observation borehole provided evidence of fracture interconnections with a nearby borehole which was subjected to pumping. Prior to the measurements, the dolomite was known to have several extensive horizontal fractures, at least one of which was characterized as having extremely high transmissivity. However, the degree of hydraulic connection of this fracture with other horizontal features was unknown. By comparing borehole-temperature distributions in the observation hole obtained prior to pumping with those obtained after pumping, major connections could be easily identified. While interpretation of the results is shown to be ambiguous in certain cases (due both to lack of corroborating data and suspected experimental error), these results did identify primary flow patterns within the observation borehole and indicated that vertical fracturing may be present between boreholes. Findings from this study are being used to guide the design of cross-hole-packer tests which will more precisely define the role of vertical fractures in the flow system. (See also W88-11031) (Author's abstract)
W88-11045

INVESTIGATING SUBSURFACE FUEL RELEASES USING AMBIENT TEMPERATURE HEADSPACE ANALYSIS,
ERT, Fort Collins, CO.
For primary bibliographic entry see Field 7A.
W88-11046

COMBINED EXPLORATION TECHNIQUES FOR FRACTURED TILL AND LOESS,
GeoEngineering, Inc., Denville, NJ.
For primary bibliographic entry see Field 7B.
W88-11047

DESIGN AND IMPLEMENTATION OF AN EFFECTIVE SOIL GAS MONITORING PROGRAM FOR FOUR-DIMENSIONAL MONITORING OF VOLATILE ORGANICS IN THE SUBSURFACE,
IEP, Inc., Westerville, OH.
For primary bibliographic entry see Field 7A.
W88-11049

TWO-DIMENSIONAL GROUND WATER FLOW MODEL OF THE DOWNTOWN INDIANAPOLIS AREA,
Indiana State Dept. of Natural Resources, Indianapolis.
T. Graves, and C. S. Porambo.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 339-357, 8 fig, 8 ref.

Descriptors: *Model studies, *Water demand, *Groundwater movement, *Urban hydrology, *Indianapolis, *Indiana, Glacial aquifers, Computer models, Wells, Pumpage, Well regulations, Groundwater potential, Drawdown.

The downtown Indianapolis area is undergoing extensive redevelopment. For several new projects, the utilization of groundwater is being considered for heating and/or cooling needs. Downtown Indianapolis sits primarily over an extensive, unconfined, glacial outwash aquifer. Many high-capacity wells presently utilize the outwash aquifer for a variety of needs. A two-dimensional groundwater-flow model of the downtown area has been constructed and calibrated by the Indiana Department of Natural Resources in an effort to study the existing groundwater utilization and to enable predictions to be made of the effects of additional high-capacity pumpage. At present, no statutory authority exists in Indiana regulating the location or effects of one high-capacity groundwater user on another. The model is intended to help the Indiana Department of Natural Resources address inquiries from potential high-capacity groundwater users contemplating water withdrawals within the modeled area. (See also W88-11031) (Author's abstract)
W88-11052

EFFECT OF CONSTRUCTION, INSTALLATION, AND DEVELOPMENT ON THE TURBIDITY OF WATER IN MONITORING WELLS IN FINE-GRAINED GLACIAL TILL,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
For primary bibliographic entry see Field 5A.
W88-11056

EVALUATION OF GROUND WATER SUPPLY SYSTEM REHABILITATION,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5G.
W88-11058

INITIAL RESPONSE TO A GROUND WATER CONTAMINATION PROBLEM, HANCOCK COUNTY, INDIANA,
Indiana Dept. of Environmental Management, Indianapolis.
For primary bibliographic entry see Field 5G.
W88-11059

ENHANCED NATURAL DEGRADATION OF A SHALLOW HYDROCARBON CONTAMINATED AQUIFER,
Groundwater Technology, Inc., Farmington Hills, MI.
For primary bibliographic entry see Field 5G.
W88-11060

USE OF MICROBIAL IN SITU TREATMENT FOR DETOXIFICATION OF A CONTAMINATED GROUND WATER,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-11061

ARMY INSTALLATION RESTORATION PROGRAM: CONTAMINATED SOIL CLEANUP

OBJECTIVES FOR AN INACTIVE ARMY AMMUNITION PLANT,
Army Biomedical Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 5G.
W88-11062

CLASS I INJECTION WELL MONITORING: ISSUES AND ANSWERS,
Golden Strata Services, Inc., Houston, TX.
For primary bibliographic entry see Field 5G.
W88-11063

LABORATORY AND FIELD EVALUATION TECHNIQUES TO DETERMINE WASTE/AQUIFER COMPATIBILITY IN UNDERGROUND INJECTION SYSTEMS,
Davis (Ken E.) Associates, Houston, TX.
For primary bibliographic entry see Field 5E.
W88-11064

APPLICATION OF THE TEMPERATURE SURVEY IN DEMONSTRATING THE MECHANICAL INTEGRITY OF INJECTION WELLS,
Davis (Ken E.) Associates, South Bend, IN.
For primary bibliographic entry see Field 7B.
W88-11065

EFFECTS OF CONSERVATION TILLAGE ON GROUNDWATER QUALITY: NITRATES AND PESTICIDES.
For primary bibliographic entry see Field 4C.
W88-11067

PROCEEDINGS OF THE FOCUS CONFERENCE ON SOUTHEASTERN GROUND WATER ISSUES.
National Water Well Association, Dublin, OH. Tampa, Florida. October 6-8, 1986. National Water Well Association, Dublin, OH. 1986. 579 p.

Descriptors: *Symposium, *Conferences, *Southeastern United States, *Groundwater pollution, *Groundwater management, *Aquifer management, Geophysics, Engineering Geology, Geology, Groundwater hydrology, Organic compounds, Hydrocarbons, Underground waste disposal, Underground storage, Storage tanks, Saline water intrusion.

The National Water Well Association FOCUS Conference on Southeastern Ground Water Issues was held in Tampa, Florida, October 6-8, 1986. Government officials, consulting engineers, hydrogeologists, geologists, researchers, industry representatives and other interested persons met to discuss Southeastern groundwater issues. The conference provided a forum for all who attended to communicate and share their experiences in the rapidly developing industry. A number of regional groundwater experts participated as invited speakers to share their knowledge on pertinent issues. Submitted and invited papers covered the following Southeastern groundwater topics: Groundwater management, defining aquifer characteristics, petroleum hydrocarbons and other organic chemicals in groundwater, underground storage tanks, salt water intrusion, and geophysical techniques in groundwater investigations. The proceedings are a compilation of papers presented by the symposium speakers. (See W88-11085 thru W88-11118) (Author's abstract)
W88-11084

INVESTIGATION OF LEAKING UNDERGROUND STORAGE TANKS AND GROUND WATER RESTORATION IN SOUTHEASTERN FLORIDA,
CH2M Hill, Deerfield Beach, FL.
For primary bibliographic entry see Field 5G.
W88-11085

APPLICATION OF CONCEPTS OF ENGINEERING TO AN UNUSUAL HYDROLOGIC PROBLEM: THE STORMWATER DRAINAGE WELLS OF ORLANDO, FLORIDA,
University of Central Florida, Orlando.
J. M. McBee, and M. P. Wanielista.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 145-163, 6 fig, 3 tab, 17 ref.

Descriptors: *Florida, *Groundwater management, *Storm sewers, *Drainage wells, *Injection wells, Well hydraulics, Hydraulics, Hydraulic engineering, Atrificial recharge, Storm water, Wells.

A detailed study was done of the quantity of water entering 208 stormwater injection (drainage) wells in the Orlando Urban Stormwater Management Manual area. Extrapolation of results to the remaining wells in Orange County is discussed briefly. Field experiments (on one 20-inch drainage well) yielded a logarithmic relationship between flow and applied head. Further analysis confirmed that a modification of the weir formula was reasonable for estimating hydraulic capacities for drainage wells of all sizes. This modified weir formula is commonly used for the design of 'morning glory' spillways for small dams which are conceptually similar to drainage wells. Hydrologic data indicates that perhaps the depressed rainfall occurring since 1960 may be a more important contributor to declining Orlando area lake levels than increased vertical leakage of ground water due to increased supply well withdrawals. Maximum hydraulic capacity and maximum capacity values show that the wells are sufficient to handle the average available runoffs, but may not be capable of handling extreme event flood flows. Therefore, other means of flood protection may be necessary. (See also W88-11084) (Miller-PTT)
W88-11095

LANDFILL LEACHATE MIGRATION IN FLORIDA'S SURFICIAL AQUIFER SYSTEM,
Northwest Florida Water Management District, Tallahassee.
For primary bibliographic entry see Field 5B.
W88-11096

CHEMISTRY OF GROUND WATERS IN THE CENTRAL FLORIDA PHOSPHATE DISTRICT,
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-11098

EXPERIMENTAL APPROACH TO DETERMINING SUBSURFACE LEAKAGE FROM A SURFACE IMPOUNDMENT USING A RADIOISOTOPE TRACER,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W88-11099

TIDALLY INDUCED WATER LEVEL FLUCTUATIONS AS A MEASURE OF DIFFUSIVITY IN A CONFINED AQUIFER -- A GRAPHICAL METHOD,
South Carolina Water Resources Commission, Beaufort.
M. S. Crouch.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 231-242, 6 fig, 1 tab, 8 ref.

Descriptors: *Surface-groundwater relations, *Tides, *Groundwater, *Aquifer characteristics, *Graphical methods, *Mathematical studies, Diffusivity, Recharge wells, Tidal effects, Field tests, Time lag method, Time drawdown analysis, Aquifers, Confined aquifers, South Carolina.

A practical method, applicable to confined aquifers affected by semidiurnal tides, for estimating the diffusivity of an aquifer is presented. Tidally induced water level fluctuations in wells penetrating confined aquifers near the coast can be used to estimate the transmissivity/storage coefficient ratio, also called diffusivity. Data from concurrent observations of tide stage and water levels in three or more wells during at least one entire tide cycle can be analyzed by two separate techniques: (1) an amplitude ratio method and (2) a time lag method. A field study was conducted on St. Helena Island, South Carolina. Observation wells were located 600, 2500, 4570, 6550 and 7600 feet from a large tidal body. Diffusivity was calculated as 1.50 times ten to the 8th power sq ft per day (161 sq m per second) by the amplitude method and 2.1 times ten to the 8th power sq ft per day (226 sq m per second) by the time lag method. Time drawdown analysis of a standard aquifer test indicated a diffusivity of 1.4 times ten to the 8th power sq ft per day (150 sq m per second). With careful work, observation of tidal fluctuations appears to be useful in making initial estimates of aquifer characteristics. (See also W88-11084) (Miller-PTT)
W88-11100

IMPORTANCE OF STRESS RELIEF FRACTURING IN PREDICTING GROUND WATER MOVEMENT AND UNDERGROUND MINING EFFECTS,
Brown Engineering, Washington, IL.
P. Sloan.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 243-262, 15 fig, 2 tab, 7 ref.

Descriptors: *Geohydrology, *Kentucky, *Groundwater movement, *Coal mining, *Model studies, *Aquifer systems, Water stress, Geologic fractures, Hydrologic models, Fracture permeability, Hydrology, Hydraulic gradient, Hydraulics, Computer models, Water table.

Hydrogeologic conditions and groundwater movement in the eastern Kentucky coal fields have become better understood in the last five years. The importance of stress-relief fracturing and fracture flow has become increasingly apparent. The current conceptual model for groundwater flow in the region is reviewed and then tested in a case study of an aquifer dewatering situation. The case study involves a small community in which 23 of 40 wells surveyed were disturbed by underground mining. Several indices, including the horizontal distance from the mine site, vertical distance from the coal seam, and hydraulic gradient were investigated to test the appropriateness of the current conceptual model for groundwater flow. The application of these indices in planning and regulation of underground mining operations is explored. MODFLOW, a three-dimensional finite difference model, is used to illustrate the groundwater system. To mainimize impact to groundwater, a buffer should be created between the mine and any potential fracture/groundwater system. The size of the buffer will depend on ones confidence in estimating the extent of the natural fracture system, the geology of the site and the extent of fracturing casued by mining. (See also W88-11084) (Miller-PTT)
W88-11101

GEOSTATISTICAL ESTIMATION OF PARAMETERS FOR THE SPARTA SAND AQUIFER -- NORTH LOUISIANA,
Louisiana Tech Univ., Ruston.
J. D. Nelson, and M. A. Hebert.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 263-286, 11 fig, 1 tab, 22 ref.

Descriptors: *Louisiana, *Arkansas, Groundwater, *Groundwater storage, *Kriging, *Aquifer characteristics, *Model studies, Statistical models, Computer models, Parametric hydrology, Hydrology, Sparta Sand Formation, Cook Mountain Foundation, Sand aquifers, Transmissivity, Conductivity, Estimating equations.

A geostatistical technique of kriging was used to estimate parameters for the Sparta Sand aquifer in northern Louisiana and southern Arkansas. Kriging is a distance-weighted moving average estimation procedure for estimating transmissivity values. This procedure estimates regionalized variables using the existing autocorrelation between known

sample points. The estimations of the Sparta Sand Formation transmissivity and the Cook Mountain Formation thickness were used in a steady state computer flow model to test their validity. Model simulations proved to be sensitive to changes in hydraulic conductivity for the Cook Mountain Formation, but was generally insensitive to changes in the Sparta Sand aquifer transmissivity. Kriging results were good initial estimates that reduced trial-and error calibration as well as the time expended to calibrate the computer model. Further calibration of the Sparta transmissivity is needed to determine if the kriging results are correct, but the cost would have to be justified. Kriging, by providing better estimates of significant parameters to groundwater models, can improve the accuracy of the prediction of water movement. (See also W88-11084) (Miller-PTT)
W88-11102

GEOLOGIC AND GEOPHYSICAL CHARACTER OF FRACTURE ZONES IN A CARBONATE AQUIFER,
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-11103

USE OF LIMITED GEOPHYSICAL LOG DATA TO DELINEATE AND CHARACTERIZE DISPOSAL AND CONFINING ZONES,
Davis (Ken E.) Associates, Baton Rouge, LA.
For primary bibliographic entry see Field 5E.
W88-11105

TERRAIN CONDUCTIVITY AS A TOOL FOR DELINEATING HYDROCARBON PLUMES IN A SHALLOW AQUIFER -- A CASE STUDY,
Woodward-Clyde Consultants, Tallahassee, FL.
For primary bibliographic entry see Field 7B.
W88-11111

NUMERICAL MODELING OF GROUND WATER FLOW AND SALTWATER TRANSPORT IN NORTHERN PINELLAS COUNTY, FLORIDA,
GeoTrans, Inc., Herndon, VA.
P. F. Andersen, H. O. White, J. W. Mercer, A. D. Truschel, and P. S. Huyakorn.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 419-449, 11 fig, 1 tab, 19 ref.

Descriptors: *Groundwater movement, *Groundwater management, *Florida, *Model studies, *Computer models, *Saline water intrusion, Geohydrology, Pumping, Groundwater recession.

Two- and three-dimensional coupled ground water flow and solute transport models of the hydrogeologic system underlying Northern Pinellas County, Florida were developed for the following reasons: (1) to gain a conceptual understanding of the processes that make this area prone to saltwater intrusion, (2) to identify areas where future data collection activities should center, and (3) to eventually provide a tool for management of ground water resources. The computer program used is a finite-element code called SWICHA that is capable of modeling density dependent ground water flow and solute transport in single and multilayered aquifers. Sensitivity simulations indicated that the properties of the hydrostratigraphic layers above and below the production zone control, to a great extent, the amount of water that can be pumped before inducing salt water intrusion. Saltwater transport in this area is an extremely slow process when compared to changes in water levels. It appears that short-term water shortages will not induce intrusion if water levels return to normal conditions. However, because it is such a slow process, intrusion may not become evident for years or even decades after an undesirable amount of stress is placed on the system. The study also led to conclusions about the applicability of numerical modeling to saltwater intrusion problems. A great deal of information can be obtained from cross-sectional models, although wellfield pumpage is difficult to characterize without the aid of a three-dimensional program. The SWICHA code is capable of performing three-dimensional simulations; however, use in a three-dimensional mode is limited. (See also W88-11084) (Author's abstract)
W88-11112

SALTWATER ENCROACHMENT STUDY AT HILTON HEAD ISLAND, SOUTH CAROLINA,
South Carolina Water Resources Commission, Beaufort.
A. D. Park.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 450-461, 7 fig, 9 ref.

Descriptors: *South Carolina, *Groundwater management, *Groundwater movement, *Aquifers, *Test wells, *Saline water intrusion, *Saline-freshwater interfaces, *Encroachment, Water level fluctuations.

The 90 million gallons per day withdrawn from the Floridan aquifer at Savannah, Georgia and Hilton Head Island, South Carolina have had a significant impact on water levels in the region. As a result, saltwater in the aquifer beneath Port Royal Sound is moving toward Hilton Head Island. In 1984, the South Carolina Water Resources Commission and U.S. Geological Survey began a 2.3 million dollar project to determine if wells at Hilton Head Island might be threatened by saltwater encroachment. The project objectives included: (1) delineating the saltwater-freshwater interface and water levels beneath Port Royal Sounds, (2) constructing a regional monitoring network, (3) developing groundwater flow and solute-transport models, and (4) recommending strategies that would optimize the use of the resource while abating saltwater encroachment. Nine test wells were drilled into the upper Floridan aquifer beneath Port Royal Sound. Data from the test wells showed that saltwater is present in the aquifer beneath much of the sound and that the 1,000 m/l isochlor at the base of the aquifer lies less than one-half mile north of Hilton Head Island. This saltwater is moving south-southwestward under a gradient of 0.5 to 0.8 ft/mi. Under these conditions, the rate of movement would be approximately 90 ft/year. Test wells have been completed at three of eight sites on Hilton Head Island to determine porosity differences within the upper Floridan aquifer and to monitor water levels and chloride concentrations. The test sites also include wells open to the water-table aquifer (30-40 feet), the Hawthorn Formation (80-110 feet), and the lower Floridan aquifer (600-900 feet). These additional wells will provide background information on water quality, geology of the lower Floridan aquifer, degree of interconnection between aquifers, and alternative sources of potable and irrigation water. (See also W88-11084) (Author's abstract)
W88-11113

STATUS OF SALT WATER INTRUSION IN SOUTH FLORIDA,
Montgomery (James M.) Consulting Engineers, Inc., Lake Worth, FL.
P. J. Gleason, C. W. Profilet, and P. F. Andersen.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 462-491, 19 fig, 10 ref.

Descriptors: *Florida, *Groundwater movement, *Aquifers, *Wells, *Saline water intrusion, Water level fluctuations, Chlorides, Monitoring, Groundwater recharge, Groundwater management.

The status of saltwater movement within the South Florida area is reviewed. Areas studied include Hallandale, Broward County, Pompano Beach, Deerfield Beach, Dania, Highland Beach, Dade County, Marco Island, Naples, and Cape Coral. The conclusions of this brief survey of saltwater intrusion problems are that: (1) saltwater is retreating and advancing in a number of locations in South Florida, (2) five Broward County utilities show evidence of saltwater intrusion, (3) movement is slow and intrusion is sensitive to recharge, (4) monitoring of both chloride concentrations and water levels in uncontaminated wells is necessary around wellfields susceptible to saltwater problems in order to effectively analyze the cause of the intrusion effectively. (See also W88-11084) (Miller-PTT)
W88-11114

POTENTIAL FOR SALTWATER INTRUSION INTO THE UPPER FLORIDAN AQUIFER, HERNANDO COUNTY, FLORIDA,
Geological Survey, Austin, TX.
P. D. Ryder, and G. L. Mahon.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 492-514, 13 fig, 20 ref.

Descriptors: *Florida, *Aquifer systems, *Model studies, *Saline water intrusion, *Test wells, Pumping, Water level fluctuations, Water quality, Chlorides, Saline-freshwater interface, Groundwater management.

There is potential for saltwater intrusion into the coastal Upper Floridan aquifer because of expected large increases in population and consequent increases in groundwater withdrawals. To gain a better understanding of the potential for saltwater intrusion, a test well was drilled to a depth of 820 ft approximately 1 mile from the coast near Aripeka in Hernando County. Freshwater was present in the carbonate rock aquifer to a depth of about 500 ft, a mixture of freshwater and saltwater occurred from 500 to 560 ft, and saltwater occurred from 560 ft to the base of the aquifer at about 750 ft. Hydraulic testing indicated the existence of a very permeable zone at a depth of 450 - 500 ft that has a transmissivity of about 56,000 sq ft/day. Water quality data show the freshwater-saltwater transition zone in the Aripeka area to be relatively thin and to have a steep slope compared to nearby coastal areas to the north and south. Digital models were used to simulate the steady state flow system and the freshwater-saltwater transition zone near Aripeka; the models were also used to simulate large hypothetical withdrawals inland from the coast. Simulation results show that coastal freshwater supply wells could experience increases in chloride concentrations as a result of increased groundwater withdrawals, depending upon the distance from the shoreline, well depth and pumping rate. (See also W88-11084) (Author's abstract)
W88-11115

INDUCED RECHARGING AND CONTAMINATION SUSCEPTIBILITY OF THE FLORIDAN AQUIFER, HILTON HEAD ISLAND, SOUTH CAROLINA,
South Carolina State Dept. of Health and Environmental Control, Columbia.
P. A. Stone, T. D. Matthews, R. L. Knox, and R. W. Oldham.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 539-559, 2 fig, 1 tab, 36 ref.

Descriptors: *South Carolina, *Groundwater pollution, *Groundwater recharge, *Aquifers, *Aquitards, *Pumping, *Infiltration, Wells, Hydraulic gradient, Path of pollutants.

Recharging characteristics of Hilton Head Island, South Carolina, were studied to predict better the susceptibility of the limestone aquifer to contamination and to evaluate the probable effects of current and proposed practices of water supply and waste disposal. It is concluded that the hydraulic potential for groundwater recharging to the limestone aquifer exists throughout Hilton Head Island. The presence of highly effective aquitards over parts of the island, including parts of the northern end, appears to greatly retard the downward movement of water. Local recharging from the surface may be insignificant in some fairly large sections of the island but this initial survey specifically investigated sites of suspected recharging. Radiocarbon evidence indicates that rapid recharging of the limestone aquifer is occurring in a rela-

tively large section of the island on the northern end and at part of the southern tip of the island. Other areas likely exist. At least one site, that of a municipal water supply well, appears to yield significant amounts of young groundwater. Recharging may be occurring at a somewhat slower rate over a wider area of the northern end of the island than that presented here. The potential for rapid contamination of this sole-source limestone aquifer is concluded from the data. (See also W88-11084) (Miller-PTT)
W88-11117

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, MAY 1985,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-11119

FINITE-ELEMENT SIMULATION MODEL FOR SATURATED-UNSATURATED FLUID DENSITY-DEPENDENT GROUNDWATER FLOW WITH ENERGY TRANSPORT OR CHEMICALLY-REACTIVE SINGLE-SPECIES SOLUTE TRANSPORT,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-11120

PROCEEDINGS TO THE NWWA FOCUS CONFERENCE ON NORTHWESTERN GROUND WATER ISSUES.
Portland, Oregon. May 5-7, 1987. National Water Well Association, Dublin, OH. 1987. 719 p.

Descriptors: *Conferences, *Groundwater, *Groundwater management, *Regional planning, *Data interpretation, *Groundwater potential, *Groundwater pollution, Glacial aquifers, Basalts, Groundwater Movement, Aquifer testing, Remedies, Professional societies.

The NWWA FOCUS Conference on Northwestern Ground Water Issues was held in Portland, Oregon, May 5-7, 1987. Government officials, consulting engineers, hydrogeologists, geologists, researchers, industry representatives and other interested persons met to learn and exchange insights regarding ground water issues of the Northwest. A number of regional ground water experts submitted papers covering the following topics: Northwestern ground water management, glacial geology and ground water, basalt and its impact on ground water resources, investigative techniques in the saturated and unsaturated zones, ground water monitoring/pollution, and remedial actions and aquifer restoration. These proceedings are a compilation of papers presented by the symposium speakers. (See W88-11122 thru W88-11137) (Author's abstract)
W88-11121

AQUIFER PROTECTION--ONE WASHINGTON CITY'S EXPERIENCE,
CH2M/Hill, Bellevue, WA.
For primary bibliographic entry see Field 5G.
W88-11123

USING THE STATISTICAL ANALYSIS SYSTEM FOR GROUND WATER DATA ANALYSIS,
Army Engineer District, Portland, OR.
J. D. Graham.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 65-71. 2 fig, 5 ref.

Descriptors: *Statistics, *Statistical analysis, *Data processing, *Groundwater data, *Graphical analysis, *Computer programs, Computers, Projections, Data interpretation, Water quality, Forecasting.

During the past 20 years there has been a marked increase in the complexity and quantity of ground water data which has been collected by numerous people and organizations for a myriad of uses. As a result, ground water data can be found on a variety of computer storage devices, such as tapes, disks, and floppies. A variety of techniques, including analytical and statistical, is necessary to analyze this data. The analysis of ground water quality data, in particular, is challenging because the concentration and movement of chemical constituents in ground water may vary both spatially and temporally. As a result, to be useful for ground water analysis, computer software must be powerful, flexible, and capable of producing high quality graphics. The Statistical Analysis System (SAS) has been chosen by the North Pacific Division, Corps of Engineers, for ground water, water quality, and other analysis. Special features of the software, including the capabilities for reading and writing complex data formats, a complete statistical package, and powerful graphics systems that include three dimensional contouring, combine to make the SAS a near ideal tool for ground water quality analysis. Additionally, the time series capability of the software is useful for forecasting statistical trends. (See also W88-11121) (Author's abstract)
W88-11125

DEWATERING AND WATER SUPPLY CONSIDERATIONS: NEW BONNEVILLE NAVIGATION LOCK,
Sweet, Edwards and Associates, Inc., Redmond, WA.
S. R. Sagstad, S. Farooqui, and D. Scofield.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 73-96. 7 fig, 3 tab, 11 ref.

Descriptors: *Groundwater depletion, *Bonneville navigation lock, *Water supply, *Navigation canals, *Locks, *Groundwater management, *Canal construction, Fish hatcheries, Drawdown, Groundwater movement.

This paper describes a ground water study for the U.S. Army Corps of Engineers in a deep alluvial aquifer at the Bonneville Navigation Lock Project. Construction dewatering of up to 60,000 gpm and ground water control of 70 ft of drawdown will impact a well field supplying over 17,000 gpm to an anadromous fish hatchery. Close coordination with the fish hatchery during the 2-3 year construction period will be necessary to maintain an uninterrupted high quality water supply to the fish hatchery. Geologic studies and aquifer tests were conducted to characterize the underlying geologic formations. Results indicate the deep alluvial aquifer is highly transmissive and regionally extensive, however direct hydraulic connection to the adjacent Columbia River is uncertain. Inducement of river recharge because of aquifer overdrafting could cause ground water temperatures to increase on both a short and long term basis. A better understanding of surface and ground water interrelationships in the vicinity of Bonneville Dam is needed. Alternative ground water supply sources were evaluated for replacement of the fish hatchery well field. The preferred system includes relocation and construction of deep wells completed in the deep alluvial aquifer. The impact of removal of 80 ft of overburden for construction of the downstream approach channel, may cause changes in ground water quality. Construction activities will be monitored and controlled to minimize aquifer contamination. (See also W88-11121) (Author's abstract)
W88-11126

PROBLEMS IN THE INTERPRETATION OF SLUG TEST DATA FROM FINE-GRAINED GLACIAL TILLS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 7B.
W88-11127

GROUND WATER FLOW AND CONTAMINANT TRANSPORT ANALYSIS IN GLACIALLY DEPOSITED FINE-GRAINED SOILS: A CASE STUDY,
Hart Crowser, Inc., Seattle, WA.
For primary bibliographic entry see Field 5B.
W88-11128

SOUTHEASTERN ALASKA HATCHERY INNOVATIVE GROUND WATER SYSTEM,
Sweet, Edwards and Associates, Inc., Kelso, WA.
H. R. Sweet, and B. Bachen.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 165-178. 8 fig, 1 tab, 2 ref.

Descriptors: *Alaska, *Fish hatcheries, *Groundwater potential, *Water supply development, *Horizontal wells, *Transmissivity, Groundwater recharge, Low flow, Salmon.

The Medvejie Hatchery produces about 500,000 chum, 60,000 coho, and 7,500 chinook adult salmon per year. The Sitka area's more than 100 inches of annual rainfall cannot guarantee adequate surface water supplies to the fish hatchery during Southeastern Alaska's 'drought' periods. Low flow occurs during mid-winter freezing and late summer. A horizontal collector was designed and installed in a glacial valley's shallow alluvium. Testing of the collector demonstrated a transmissivity of about 200,000 sq ft/day (1-2 million gal/day/ft) in the 20 feet thick gravel aquifer. Data from the aquifer test, coupled to basin recharge and runoff models, showed 20 to 30 cubic feet per second of ground water to be available during low flow periods. Aquifer performance and collector efficiency testing support a potential sustained pumping capacity of 6.5 million gallons per day or 10 cubic feet per second. This water supply increase at the hatchery allows expansion of the hatchery from 7,500 to 36,000 Chinook adults per year, with a current value increase from $300,000 to $1.4 million per year. (See also W88-11121) (Author's abstract)
W88-11130

SWIFT CURRENT VALLEY: A GLACIALLY DISRUPTED BURIED-VALLEY AQUIFER SYSTEM,
Hardy BBT Ltd., Calgary (Alberta).
A. Slawinski, and P. Glen.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 179-201. 43 ref.

Descriptors: *Saskatchewan, *Buried rivers, *Aquifer characteristics, *Geohydrology, *Glacial soils, Glacial drift, Well data, Well logs, Hydrologic maps, Reviews, Swift Current Valley, Canada, Geological surveys, Aquifer systems, Literature review.

The Swift Current buried valley extends between longitudes 108 degrees and 104 degrees west and latitudes 50 degrees and 51 degrees north, in southwestern Saskatchewan. The valley represents a considerable potential for ground water development and use. The Empress group forms an aquifer extending possibly over some 580 sq miles (1500 sq km). Intertill aquifers may be almost as extensive. The present study, undertaken on behalf of the Saskatchewan Water Corporation, involved a review of all existing hydrogeological information pertaining to the Swift Current Valley including published reports, maps, papers, unpublished reports, water well logs, geophysical well logs, hydrochemical data and ground water production records. The purpose of the study was to provide a better understanding of the regional hydrogeology of the Swift Current Valley in order to evaluate development potential and allow for improved management of the available ground water resources. The current usage has been evaluated at 8.68 x 10 to the 8th power USG per year (3,300,000 cu m/yr). The amount of water which might be withdrawn from the aquifer system without adverse effect on storage is calculated to be one order of magnitude greater than the present usage. Efficient and cost effective methods of water quality improvement may presently offer the greatest challenge for larger domestic and munici-

pal use of ground water from the Swift Current Valley. (See also W88-11121) (Author's abstract)
W88-11131

HYDROGEOLOGY OF THE SOUTHSIDE AQUIFER, SAGLE, IDAHO,
Idaho Div. of Environment, Pocatello.
J. S. De Smet.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 203-233. 4 fig, 11 ref, 4 append.

Descriptors: *Geohydrology, *Aquifer characteristics, *Idaho, *Glacial soils, *Geomorphology, *Groundwater movement, Water table profiles, Well logs, Reviews, Valleys, Southside aquifer, Data interpretation.

This report presents data relating to the hydrogeologic characteristics of a little known glacial aquifer in northern Idaho. The Southside Aquifer is a small aquifer that is the sole source of water for approximately 2000 people. Well logs and geomorphic features are used to interpret geologic origin and infer hydrogeologic characteristics of aquifer media. Static water levels and well head elevations at selected locations are used to create profiles to determine direction of ground water flow. Depth to ground averages 51 feet in the aquifer. Even shallower depths occur in perched water tables and in topographic valleys. These valleys are also the major transportation routes in the area making the area very vulnerable to contamination. The cumulative effects of rural residential development may also have an adverse effect in the future and should be considered in planning. (See also W88-11121) (VerNooy-PTT)
W88-11132

IMPACT UPON PRESSURE HEAD WHEN WELLS PENETRATE MULTIPLE BASALT AQUIFERS NEAR MOSIER, OREGON,
Oregon State Water Resources Dept., Salem. Ground Water Div.
K. E. Lite, and G. H. Grondin.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 267-271. 2 ref.

Descriptors: *Pressure head, *Fully penetrating wells, *Aquifer characteristics, *Wells, *Groundwater depletion, Geologic fractures, Overdraft, Oregon, Basalt, Well regulations.

High pressure conditions exist within three basalt aquifers in the Mosier Syncline south of Mosier, Oregon. The high pressure results form the impoundment of ground water by two faults. The aquifers occur within weathered vesicular zones and locally in fractures and interflow sediments within three members of the Columbia River Basalt Group. The piezometric surface elevation appears higher for the middle basalt aquifer than for the upper and lower basalt aquifers. Wells interconnecting the middle basalt aquifer to the upper and lower basalt aquifers allow water to drain from the middle aquifer to the other aquifers. An apparent overdraft of the upper aquifer probably exacerbates this situation. The pressure head in the middle aquifer is declining as a result. In addition, the pressure head relative to the middle aquifer in interconnecting wells is lower than for wells isolating the middle aquifer. The draining water causes the reduced pressure head, and it apparently makes the wells less productive. Designing wells to isolate the middle aquifer would prevent the wasteful loss of water from that resource, and it may increase the productivity of those wells. Better identification and characterization of aquifers statewide combined with enforcement of stringent well construction standards would protect and ensure better use of Oregon's ground water resource. (See also W88-11121) (Author's abstract)
W88-11134

GEOLOGIC AND HYDROGEOLOGIC CHARACTERIZATION OF A HAZARDOUS WASTE DISPOSAL SITE, ARLINGTON, OREGON,
Engineering Enterprises, Inc., Long Beach, CA.
For primary bibliographic entry see Field 5E.
W88-11135

APPLICATION OF REMOTE DATA ACQUISITION SYSTEMS IN ASSESSING GROUND WATER FLOW DIRECTIONS,
Hart Crowser, Inc., Seattle, WA.
For primary bibliographic entry see Field 7B.
W88-11136

PERCHED WATER IDENTIFICATION WITH RADIATION LOGS,
Washington State Univ., Pullman.
E. P. Poeter.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 313-327. 8 fig, 7 ref.

Descriptors: *Radioactive well logging, *Neutron-epithermal neutron logs, *Gamma-gamma logs, *Piezometers, *Perched water, *Perched water table, Gamma radiation, Logging, Geophysics, Water level fluctuations, Environmental effects, Waste dumps.

The presence, nature, and extent of perched zones are frequently important during investigation of potential waste disposal sites and contaminated sites. Often such zones are overlooked and cased off during drilling and completion of monitor wells. Typically large differences in water levels over short distances are the first indicator that perched conditions may exist at a site. Installation of piezometers can provide conclusive evidence of the presence, nature and extent of perched zones, but such activity is costly and time consuming. Combined interpretation of the gamma-gamma (GG) and neutron-epithermal neutron (NN) geophysical logs can assist in evaluating perched conditions and guide placement of additional piezometers in an effective and efficient manner. Subsequently, logs from the shallow portion of existing wells that are completed in deeper zones can be used to interpolate and extrapolate knowledge of perched conditions. Perched zones are often indicated on logs by an inverse response of the GG and NN logs underlain by a direct response of the same logs. Because interpretation of geophysical logs is non-unique, they cannot provide conclusive evidence as to whether a particular zone is saturated or unsaturated. Limitations on conditions that will result in a false response can be determined. When logs are used in conjunction with hydrologic and geologic information they are a valuable tool for investigating zones of perched ground water. (See also W88-11121) (Author's abstract)
W88-11137

PREDICTING PLUME CHARACTERISTICS FROM PUMPING WELL CONCENTRATIONS USING A ONE-DIMENSIONAL ANALYTICAL SOLUTION,
Hydrosystems, Inc., Falls Church, VA.
For primary bibliographic entry see Field 5B.
W88-11138

CONTAMINANT EVALUATION OF THE DUWAMISH RIVER VALLEY, SEATTLE, WASHINGTON,
Converse Consultants, Inc., Seattle, WA.
For primary bibliographic entry see Field 5B.
W88-11139

MONITORING SURFACE SOIL GAS FOR DELINEATING GROUND WATER CONTAMINATION BY PETROLEUM,
Idaho Div. of Environment, Boise.
For primary bibliographic entry see Field 5A.
W88-11140

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART I. CONCEPTUALIZATIONS,
Oregon Graduate Center, Beaverton.
For primary bibliographic entry see Field 7B.
W88-11144

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART II. CASE HISTORIES,
Oregon Graduate Center, Beaverton.
For primary bibliographic entry see Field 7B.
W88-11145

RECENT ADVANCES IN THE DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN GROUND WATER,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5A.
W88-11146

GROUNDWATER POLLUTION POTENTIAL OF AIR FORCE INSTALLATIONS ON GLACIAL, ALLUVIAL, AND BASALT DEPOSITS OF THE NORTHWEST - WASHINGTON, OREGON, AND IDAHO,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 5B.
W88-11147

GROUND WATER INVESTIGATION AND DATA COMPILATION FOR GAS WORKS PARK, SEATTLE, WASHINGTON,
Tetra Tech, Inc., Bellevue, WA.
W. G. Hansen, and K. E. Schmierer.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 591-606. 8 fig, 4 ref.

Descriptors: *Groundwater pollution, *Coal gasification, *Hydrologic data collections, *Pollutant identification, *Data collections, *Seattle, *Washington, Stratigraphy, Monitoring wells, Soil tests, Water pollution sources, Data processing.

Gas Works Park is a 20-ac (8.1-ha) site located on Lake Union, north of Seattle's downtown area. Prior to 1956, the site was a coal and oil gasification ('town gas') facility for the Seattle area and was subsequently inactive. From 1973 to 1978, the site was developed as a city park, with selective preservation of historical gas works equipment. During 1983 and 1984, concerns arose regarding industrial residues still present in the subsurface soils that were generated by the plant's operation. The concerns prompted a series of surface and subsurface soil sampling efforts by the U.S. EPA, the University of Washington, and Tetra Tech (on behalf of Seattle's Dept. of Parks and Recreation). Fifteen ground water monitoring wells (and one offsite well) were installed throughout the park to determine whether these residues are impacting ground water and nearby Lake Union. Water samples from these wells were analyzed for polynuclear aromatic hydrocarbons (PAH) and other organic contaminants and metals. The objectives of the ongoing investigation are to characterize the natural and anthropogenic stratigraphy of the site and to determine potential impacts on the sediment and water quality of Lake Union. An important investigative tool is a computerized database, which has been compiled from all the results of previous and ongoing investigations. This database enables the user to specify an area and vertical cross section in the park and obtain summaries of all chemical analyses, soil observations, bore-hole logs, and existing or previous gas plant structures in the specified area. Investigation results will enable the city to determine an appropriate course of action for the park. (See also W88-11121) (Author's abstract)
W88-11151

RURAL LANDFILL SITE CHARACTERIZATION, PUBLIC HEALTH ASSESSMENT AND REMEDIAL ACTION, KING COUNTY, WASHINGTON,
Sweet, Edwards and Associates, Inc., Redmond, WA.

For primary bibliographic entry see Field 5E.
W88-11152

UNIQUE CLEANUP SOLUTION TO POLYCYCLIC AROMATIC HYDROCARBON CONTAMINATION FROM A 19TH CENTURY COAL GASIFICATION PLANT,
Hart Crowser, Inc., Seattle, WA.
For primary bibliographic entry see Field 5G.
W88-11154

SMALL SCALE RECOVERY OF HYDROCARBONS IN GROUND WATER: A CASE STUDY,
Smith (Roger N.) Associates, Inc., Portland, OR.
For primary bibliographic entry see Field 5G.
W88-11155

REMEDIATION AT A MAJOR SUPERFUND SITE, WESTERN PROCESSING, KENT, WASHINGTON,
HDR Infrastructure, Inc., Seattle, WA.
For primary bibliographic entry see Field 5G.
W88-11157

PROCEEDINGS OF THE ASSOCIATION OF GROUND WATER SCIENTISTS AND ENGINEERS SOUTHERN REGIONAL GROUND WATER CONFERENCE.
San Antonio, Texas. September 18-19, 1985. National Water Well Association, Worthington, OH. 1986. 442 p.

Descriptors: *Groundwater pollution, *Contamination, *Monitoring wells, *Injection wells, *Underground storage, *Storage tanks, *Groundwater recharge, *Groundwater movement.

The Association of Ground Water Scientists and Engineers Southern Regional Ground Water Conference covered several topics, including groundwater and contamination flow through fractured rock, groundwater contamination investigations and remediation, monitoring well construction, subsurface injection wells, leaking underground storage tanks, artificial groundwater recharge and the application of groundwater models. Government officials, consulting geologists, engineers and researchers, industry representatives and other interested persons met to learn and discuss state-of-the-art techniques employed in groundwater studies. The conference provided a forum for all who attended to communicate and share their experiences in the subject areas discussed. These proceedings are a compilation of papers presented by the speakers. (See W88-11183 thru W88-11212) (Author's abstract)
W88-11182

INFLUENCE OF BARRIER FAULTS ON GROUND WATER FLOW IN THE EDWARDS AQUIFER, SAN ANTONIO REGION, TEXAS,
Geological Survey, San Antonio, TX.
R. W. Maclay, L. F. Land, and D. G. Woodward.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 1-13, 6 fig, 8 ref.

Descriptors: *Geologic fractures, *Edwards Aquifer, *Texas, *Groundwater barriers, *Groundwater movement, Flow pattern, Stratigraphy, Mathematical models, Geohydrology, Springs, Aquifers.

The groundwater flow pattern of the Edwards aquifer in the San Antonio region is controlled primarily by the presence and continuity of permeable strata within the Edwards aquifer and by faults that abruptly disrupt the lateral continuity of these permeable strata. Barrier faults commonly occur in the Balcones fault zone and substantially affect the direction of groundwater flow, particularly in northern Medina County where flow is diverted to the southwest. Barrier faults also function as impoundment structures within the unconfined zones of the Edwards aquifer. Some barrier faults also function as internal structures that control the flow toward and the natural discharge of major springs in the eastern part of the San Antonio region. A regional mathematical model of the Edwards aquifer has been constructed to show detailed flow vectors that conform with the regional flow pattern as interpreted from hydrologic and geologic data. (See also W88-11182) (Author's abstract)
W88-11183

DELINEATION OF SEPARATE FLOW REGIMES IN THE EDWARDS AQUIFER: A MEANS OF SUSTAINING THE SAN MARCOS SPRINGS DISCHARGE,
Southwest Texas State Univ., San Marcos.
For primary bibliographic entry see Field 4B.
W88-11184

HYDROCHEMISTRY AS A MEANS OF DEFINING FLOW REGIMES WITHIN A FRACTURED LIMESTONE AQUIFER,
Southwest Texas State Univ., San Marcos.
D. L. Lunsford, and A. E. Ogden.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 33-49, 13 fig, 1 tab, 10 ref.

Descriptors: *Geochemistry, *Sam Marcos Springs, *Texas, *Edwards Aquifer.*Groundwater movement, *Flow pattern, *Springs, Chemical composition, Limestone, Water chemistry, Aquifers, Wells, Chlorides, Sulfates, Groundwater recharge, Water quality, Stratigraphy, Seasonal variation.

When it was discovered that the various orifices of the San Marcos Springs in Texas were not uniform in chemical composition but could be divided into two groups, an extensive well sampling project was undertaken to increase understanding a flow regimes in the Edwards Aquifer from well water chemistry. Ten wells were monitored bimonthly for one year to detect seasonal and recharge affects on chemistry and static water levels around San Marcos. Chloride and sulfate were affected the least. Chemical changes were affected by depth to groundwater, stratigraphic position, and proximity to the Bad Water line. The maximum static water level change was only 13 ft. This small amount of change is attributed to the great volume of interconnected caverns in the aquifer and the close proximity of the San Marcos Springs. Water quality tests during well pumping showed that in general, a representative sample could be obtained after one well volume had been removed. Ninety wells were sampled during a 3-wk period for the purpose of producing isocon maps and 3-D fishnet diagrams of each measured parameter. Chloride and sulfate were the most useful in defining flow pattern because they had the least seasonal variability. Anomalously high concentrations of chloride and sulfate are attributed to wells that intersect areas of slow groundwater circulation containing evaporitic deposits. Chloride and sulfate isocons demonstrate that the concentrations of these two ions gradually increase from the Recharge Zone to the San Marcos Springs and Bad Water Line. Groundwaters in fracture systems along which Sink and Purgatory creeks have formed cause significant dilution of the ionic constituents. It is believed that additional recharge dams on Sink and Purgatory creeks and the Blanco River will add substantial recharge to the Edwards Aquifer and the San Marcos Springs. (See also W88-11182) (Author's abstract)
W88-11185

EFFECT OF RAINSTORM EVENTS ON SPRING WATER CHEMISTRY IN LIMESTONE TERRANE,
Arkansas Univ., Fayetteville. Dept. of Geology.
K. F. Steele, R. K. Widmann, D. S. Wickliff, and D. L. Parr.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 50-66, 7 fig, 4 tab, 10 ref.

Descriptors: *Groundwater recharge, *Surface-groundwater relations, *Karst hydrology, *Recharge, *Groundwater movement, *Rainfall infiltration, Aquifers, Groundwater, Chemical composition, Limestone, Springs, Rainstorms, Flow rates, Seasonal variation, Hydrogen ion composition, Calcium, Strontium, Alkalinity, Nitrates, Potassium, Ammonia, Orthophosphates, Chloride, Sodium, Magnesium, Silica, Dissolved solids, Hydrographs.

A hydrogeochemical investigation was conducted in the Boone-St. Joe Aquifer in Northwest Arkansas to determine the effect of rainstorm events on groundwater chemistry in limestone terrane. Springs utilized are located on linears (major fractures) making the spring water susceptible to recharge effects. Samples were collected before, during and after significant rainfall events (1 in). The changes in ion concentration associated with rain events is about equal to or as much as 3 times that associated with seasonal variation (determined by samples collected at least 5 days after major rain events). Some parameters (specific conductivity, pH, total alkalinity, calcium and strontium) exhibit decreasing values with increasing spring flow rates and reach minimum values at the peak of the storm hydrograph. These trends are the result of dilution by the low total dissolved solids recharge water. The changes in concentration of the other ions (potassium, ammonia and orthophosphate) parallel the changes in spring flow and are caused by the recharge water flushing these ions from surface sources. The behavior of nitrate, chloride, sodium, magnesium and silica depends on their availability. They may exhibit dilution effects, flushing effects or a combination of these effects depending on the spring and conditions of the spring recharge basin prior to the rainstorm. All springs exhibited the same general pattern for dilution and flushing effect of ions despite background flow rate differences as great as 30 times. (See also W88-11182) (Author's abstract)
W88-11186

RECHARGING RELATIONSHIPS AND CONTAMINATION SUSCEPTIBILITY OF FRACTURED CRYSTALLINE-ROCK AQUIFERS IN THE PIEDMONT AND BLUE RIDGE PROVINCES OF SOUTH CAROLINA,
South Carolina State Dept. of Health and Environmental Control, Columbia.
For primary bibliographic entry see Field 5B.
W88-11187

HYDROGEOLOGIC EVALUATION OF A SANITARY LANDFILL SITE IN KARST TERRAIN OF NORTHWEST ARKANSAS,
Ozark Geological Services, Inc., Fayetteville, AR.
For primary bibliographic entry see Field 5E.
W88-11188

HYDROGEOLOGIST AND DATA ACQUISITION FOR AQUIFER MODELING: QUO VADIS,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
J. K. Yu, G. R. New, and R. C. Wooten.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 304-314, 1 fig, 1 tab, 29 ref.

Descriptors: *Model studies, *Aquifer testing, *Aquifers, *Groundwater movement, *Flow pattern, *Computer models, Data acquisition, Geohydrology, Stratigraphy, Hydraulics, Pump wells, Observation wells.

Experience gained from the U.S. Air Force Installation Restoration Program (IRP) indicates that groundwater computer models may be useful tools for resource management. The prudent computer modelers have developed groundwater models using sophisticated mathematical algorithms to simulate aquifer flow patterns and solute transport. However, the acquisition of the model input parameters rests upon the shoulders of those per-

forming the field work. The hydrogeologist must define the subsurface stratigraphy and lithology and their associated geohydraulic parameters such as directional transmissivities, storativities of pumping and injection, boundary and initial conditions, leakance and storativity of the upper or lower confining clay beds, etc. It is evident that the standard aquifer test for water supplies (one pumping well and one observation well) is not sufficient for acquiring these computer input parameters. The hydrogeologist must go beyond the standard test, and devise methods for obtaining the above parameters to utilize existing models more fully. An aquifer test design is recommended to bridge the gap between model development and application. (See also W88-11182) (Author's abstract)
W88-11203

PRELIMINARY RESULTS OF A STEADY-STATE GROUND WATER FLOW MODEL OF THE SOUTHEASTERN COASTAL PLAIN REGIONAL AQUIFER SYSTEM,
Geological Survey, Atlanta, GA.
R. A. Barker.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 315-338, 13 fig, 17 ref.

Descriptors: *Southeastern Coastal Plain, *Model studies, *Groundwater movement, *Aquifers, *Flow pattern, *Finite difference method, Streams, Groundwater recharge, Hydraulic budget.

A finite-difference flow model was developed for the Southeastern Coastal Plain aquifer system that underlies about 120,000 square miles in parts of Mississippi, Alabama, Georgia, and South Carolina. In addition to aiding concurrent efforts to map the geology of the study area, the model is helping determine the regional distribution of hydraulic head, aquifer and confining zone properties, and groundwater flow. Model design is based on a geohydrologic framework that distinguishes aquifers from confining beds in accordance with large-scale objectives. The simulated system is comprised of four regional aquifer units and three confining units whose physical boundaries do not everywhere correspond to time- or rock-stratigraphic counterparts. The model provides a steady-state simulation of the relatively deep groundwater flow system beneath the level of small streams that are affected by groundwater discharge from relatively shallow aquifers of local scale. Model input recharge to the intermediate-to-regional scale flow system averages about 1 inch/year and the simulated base flow from this system to major streams averages about 3/4 inch/year. The residual between the model input recharge and the simulated base flow averages about 1/4 inch/year. This residual infiltrates the deep aquifer system and eventually discharges as diffuse upward leakage. A water budget for the Southeastern Coastal Plain aquifer system is given. (See also W88-11182) (Author's abstract)
W88-11204

STUDY OF GROUND WATER FROM AN AGRICULTURAL AREA,
Alabama Univ., University.
For primary bibliographic entry see Field 5B.
W88-11210

CASE STUDIES IN WATER SUPPLY DEVELOPMENT BY GEOTHERMETRY TECHNIQUE,
K. N. Manesh.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 427-442, 2 fig, 1 tab, 11 ref.

Descriptors: *Groundwater prospecting, *Geophysics, *GEOTHERMETRY technique, *Thermal conductivity, *Hydrologic data collections, Groundwater movement, Aquifers, Rock aquifers.

Geophysical techniques for groundwater prospecting go as far back as the peach tree branch and ground sniffing. In recent years, electrical resistivity and seismic investigations have been commonly and widely used for delineating water bearing channels in glacial till and in erosional channels in rock systems. A lesser known method of investigation, which utilizes the thermal gradient dissipation through the soil, can also be used for prospecting for groundwater. This method has been named GEOTHERMETRY by Layne-Western Company. The technical and mathematical development of the methodology are discussed and the results of case studies conducted both in glacial (Sabetha, Nebraska) and in deep carbonated rock systems (Corinth, Mississippi) are presented. Construction of the GEOTHERMETRY holes consisted of placement of 1-2 in. PVC pipe up to depths of 50 ft below ground level. In Sabetha, 27 temperature monitoring stations were constructed while at Corinth a total of 88 stations was required. Homogeneity of the overburden below the critical depth determines the success or ineffectiveness of GEOTHERMETRY. Absolute temperature measurements are not indicative of any particular aqifer property but the relative measurements can qualify the relationship that may exist between different formations and velocities. (See also W88-11182) (Author's abstract)
W88-11212

PROCEEDINGS OF THE NWWA/API CONFERENCE ON PETROLEUM HYDROCARBONS AND ORGANIC CHEMICALS IN GROUND WATER: PREVENTION, DETECTION AND RESTORATION.
National Water Well Association, Dublin, OH.
For primary bibliographic entry see Field 5G.
W88-11213

SOME EUROPEAN PERSPECTIVES ON PREVENTION OF LEAKS FROM UNDERGROUND PETROLEUM STORAGE SYSTEMS,
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 5G.
W88-11215

MIGRATION OF CHLORINATED HYDROCARBONS IN GROUNDWATER,
City Coll., New York. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-11216

DEVELOPMENT AND VALIDATION OF THE UNDERGROUND LEAK TRANSPORT ASSESSMENT MODEL (ULTRA),
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 7B.
W88-11217

BIOLOGICAL FATE OF HYDROCARBONS AT AN AVIATION GASOLINE SPILL SITE,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
For primary bibliographic entry see Field 5B.
W88-11218

FACILITATED TRANSPORT OF NAPHTHALENE AND PHENANTHRENE IN A SANDY SOIL COLUMN WITH DISSOLVED ORGANIC MATTER - MACROMOLECULES AND MICELLAS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W88-11219

DATA ANALYSES AND COMPUTER MODELING OF THE BENZENE PLUME IN AN AQUIFER BENEATH A GAS PLANT,
For primary bibliographic entry see Field 5B.
W88-11223

MODELING MULTIPHASE CONTAMINANT TRANSPORT IN GROUND WATER AND VADOSE ZONES,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5B.
W88-11225

MTBE AS A GROUND WATER CONTAMINANT,
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 5B.
W88-11227

IRON DISSOLUTION RESULTING FROM PETROLEUM-PRODUCT CONTAMINATION IN SOIL AND GROUND WATER. 1. THERMODYNAMIC CONSIDERATIONS,
Weston (Roy F.), Inc., Albuquerque, NM.
For primary bibliographic entry see Field 5B.
W88-11229

STATISTICAL REVIEW OF GROUND WATER DATA FROM WASTE DISPOSAL SITES,
Browing-Ferris Industries, Houston, TX.
For primary bibliographic entry see Field 5A.
W88-11232

ROLE OF GEOLOGIC CHARACTERIZATION IN DETERMINING MIGRATION OF HYDROCARBON SPILLS: A CASE STUDY,
EMCON Associates, San Jose, CA.
For primary bibliographic entry see Field 5G.
W88-11234

EVALUATION OF A PASSIVE SAMPLING SOIL-GAS SURVEY TECHNIQUE FOR DETECTING VOLATILE ORGANIC COMPOUNDS,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11237

AQUIFER RESTORATION: COMPREHENSIVE ADDRESS TO ORGANIC CHEMICAL CONTAMINATION,
For primary bibliographic entry see Field 5G.
W88-11242

UNDERGROUND FUEL CONTAMINATION, INVESTIGATION, AND REMEDIATION: A RISK ASSESSMENT APPROACH TO HOW CLEAN IS CLEAN,
EA Engineering, Science, and Technology, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5G.
W88-11243

'REALISTIC' COST ESTIMATES FOR ALTERNATIVE REMEDIAL ACTIONS OF CONTAMINATED, UNSATURATED SOILS AND UNDERLYING AQUIFERS,
Canonie Environmental Services Corp., San Mateo, CA.
For primary bibliographic entry see Field 6E.
W88-11244

CONSIDERATIONS FOR OPTIMIZATION OF ABATEMENT SYSTEM DESIGN,
Groundwater Technology, Inc., Chadds Ford, PA.
For primary bibliographic entry see Field 6A.
W88-11245

EVAPORATION OF BENZENE, TOLUENE, AND O-XYLENE FROM CONTAMINATED GROUND WATER,
Geraghty and Miller, Inc., Oak Ridge, TN.
For primary bibliographic entry see Field 5D.
W88-11246

SWAPS, AN AUTOMATED LIQUID HYDROCARBON RECOVERY SYSTEM,

Amoco Corp., Tulsa, OK.
For primary bibliographic entry see Field 5G.
W88-11247

REMEDIATION OF GASOLINE-CONTAMINATED GROUND WATERS: A CONTROLLED FIELD EXPERIMENT,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5G.
W88-11248

TREATMENT OF CONTAMINATED GROUND WATER WITH MEMBRANE SEPARATION TECHNOLOGIES,
C3 International, Minneapolis, MN.
For primary bibliographic entry see Field 5G.
W88-11249

HYDROGEOLOGIC ASSESSMENT, DELINEATION, AND REMEDIATION OF A SHALLOW GROUND WATER CONTAMINATED ZONE,
CIBA-GEIGY Corp., St. Gabriel, LA.
For primary bibliographic entry see Field 5G.
W88-11250

ON-SITE RESTORATION TECHNIQUE FOR THE REMEDIATION OF SOILS CONTAINING HYDROCARBON CONSTITUENTS,
Canonie Environmental Services Corp., Porter, IN.
For primary bibliographic entry see Field 5G.
W88-11251

TREATMENT AND REMOVAL OF DISSOLVED ORGANICS AND INORGANICS IN A CONTAMINATED GROUND WATER - A CASE STUDY,
Stover and Associates, Stillwater, OK.
For primary bibliographic entry see Field 5G.
W88-11253

VACUUM ENHANCED HYDROCARBON RECOVERY: A CASE STUDY,
Engineering Enterprises, Inc., Norman, OK.
For primary bibliographic entry see Field 5G.
W88-11254

OCCURRENCE AND RECOVERY OF A DNAPL IN A LOW YIELDING BEDROCK AQUIFER,
Environmental Resources Management, Inc., West Chester, PA.
For primary bibliographic entry see Field 5G.
W88-11255

DESIGN AND IMPLEMENTATION OF A GROUND WATER REMEDIATION PROGRAM AT LOUISIANA'S PRIORITY SUPERFUND SITE,
IT Corp., Baton Rouge, LA.
J. B. Cange, D. C. Saxton, and S. M. Cange.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 737-754, 8 fig, 1 tab, 4 ref.

Descriptors: *Groundwater pollution, *Cleanup operations, *Waste recovery, *Water pollution treatment, *Remedies, Volatility, Aromatic hydrocarbons, Louisiana, Interceptor trenches, Dewatering.

A ground water recovery and hydraulic control system is described that incorporates both active and active/passive recovery methods, for the Phase IV Remedial Action stage of the Old Inger Waste Oil Refinery in Darrow, LA. Groundwater contamination at the site included a number of volatile organic and polynuclear aromatic compounds. Components of the recovery system include shallow (20-ft) recovery wells for the active withdrawal of contaminated ground water and non-aqueous phase liquids (NAPLs) from a semi-confined silt aquifer. Active/passive recovery will be accomplished via excavation dewatering and a 500-foot long interceptor trench (French drain). Recovered liquids will be transferred to the on-site wastewater treatment unit. In addition to contaminant withdrawal, these components will exert considerable influence on the potentiometric surface of the site's shallow aquifer, enhancing containment of the contaminant plume within the general boundaries of the site. (See also W88-11213) (Author's abstract)
W88-11256

ADVANCED STAGES OF A HYDROCARBON RECOVERY/CLOSED LOOP HYDROCARBON FLUSHING SYSTEM SUCCESSFUL IN A HIGHLY PERMEABLE GLACIAL OUTWASH IN APPLE VALLEY, MINNESOTA,
Leggette, Brashears and Graham, Inc., St. Paul, MN.
For primary bibliographic entry see Field 5G.
W88-11257

SHP PUMPS - A NEW APPROACH TO THE RECOVERY OF SUBSURFACE PETROLEUM HYDROCARBONS,
Templar Associates Ltd., Blacksburg, VA.
For primary bibliographic entry see Field 5G.
W88-11258

IMPLEMENTATION OF A HYDRAULIC BARRIER UTILIZING AN EXTRACTION AND INJECTION WELL SYSTEM,
EMCON Associates, San Jose, CA.
For primary bibliographic entry see Field 5G.
W88-11259

ASSESSMENT AND MANAGEMENT OF A 15-YEAR-OLD VOC GROUND WATER CONTAINMENT PLUME,
Traverse Group, Inc., Ann Arbor, MI.
For primary bibliographic entry see Field 5G.
W88-11260

2G. Water In Soils

DIRECT DETERMINATION OF PERMEABILITY OF CLAY UNDER EMBANKMENT,
Laval Univ., Quebec. Dept. of Civil Engineering.
S. Leroueil, M. Diene, F. Tavenas, M. Kabbaj, and P. La Rochelle.
Journal of Geotechnical Engineering JGEND2, Vol. 114, No. 6, p 645-657, June 1988. 8 fig, 16 ref. Natural Sciences and Engineering Research Council of Canada Operating Grants A7724, A7379, and A1503, and Strategic Grant G-0851.

Descriptors: *Bank stability, *In situ tests, *Permeability, *Clays, *Embankments, Pore pressure, Consolidation, Permeability coefficient, Comparison studies, Permeameters, Piezometers, Porous media, Consolidation coefficient.

Numerous methods are used to measure the permeability of clays in the laboratory and in situ. It is well known that these methods lead to different permeability coefficient (k) values, but, until now, no comparison with the 'real in situ permeability' has been carried out. In this paper a method based on the observation of pore pressure isochrones and settlement rates under embankments is proposed to determine the 'real' in situ k value at various depths and at various times and strains. This method is successfully applied to the Berthierville test embankment where different permeability tests have been carried out. The embankment was built in 1983 and its behavior has been observed by others during the three following years. Our results show that on this site the 'real' in situ permeability is slightly higher than the permeability obtained by direct measurement in the laboratory, and the coefficient of permeability deduced from consolidation coefficient values strongly underestimates the in situ permeability. The coefficient of permeability measured with the self-boring permeameter is representative of the 'real' in situ permeability, while the coefficient measured by means of pushed-in-place piezometers underestimates it. (Author's abstract)
W88-10193

CONTRIBUTION OF SOIL MOISTURE STORAGE TO THE WATER BALANCES OF UPLAND FORESTED AND GRASSLAND CATCHMENTS,
Institute of Hydrology, Powys (Wales).
For primary bibliographic entry see Field 2A.
W88-10402

SHALLOW-PROBE SOIL-GAS SAMPLING FOR INDICATION OF GROUND-WATER CONTAMINATION BY CHLOROFORM,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-10523

EFFECT OF RAINWATER QUALITY ON SOIL WATER AND SOIL PROPERTIES,
Finnish Forest Research Inst., Helsinki. Dept. of Forest Genetics.
For primary bibliographic entry see Field 5C.
W88-10557

INFLUENCE OF EVAPOTRANSPIRATION AND PRECIPITATION ON LONG-TERM CHANGES IN EXCHANGEABLE BASE CATIONS IN FOREST SOIL (METSAMAAN VESITALOUDEN VAIKUTUKSESTA EMASKYLASTY SASTEEN PITKAAIKAISIIN MUUTOKSIIN),
Helsinki Univ. (Finland).
For primary bibliographic entry see Field 5C.
W88-10558

EFFECT OF TILLAGE PRACTICES ON INFILTRATION AND SOIL STRENGTH OF A TYPIC HAPLUDULT SOIL AFTER TEN YEARS,
Georgia Univ., Athens. Dept. of Agronomy.
D. E. Radcliffe, E. W. Tollner, W. L. Hargrove, R. L. Clark, and M. H. Golabi.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 3, p 798-804, May/June 1988. 7 fig, 4 tab, 30 ref.

Descriptors: *Soil water, *Cultivation, *Soil strength, *Density, *Soil physical properties, *Agricultural engineering, *Infiltration, Porosity, Soil types, Soil density, Rainfall impact, Cone index, Macroporosity, Mulch, Topsoil.

Highly weathered soils of the Southeastern USA are poorly structured and may present special problems under continuous no-tillage production Soil physical properties were examined in a long-term tillage experiment starting in its 10th year to determine if there were differences due to tillage. Fall/spring tillage treatments consisted of moldboard plow/moldboard plow (CT), moldboard plow/no-tillage (MT), and no-tillage/no-tillage (NT). Cone index measurements in NT exceeded 4 MPa at a depth of 0.10 to 0.20 m, indicating the presence of a compacted zone. Bulk density was significantly higher that CT at this depth also (1.60 vs 1.40 Mg/cu m). Spring planting traffic compacted the top 0.15 m in all treatments. Infiltration rates, measured with a sprinkler infiltrometer, were significantly higher in NT. The straw mulch (5000 kg/ha) and layer of fine organic litter at the surface of NT prevented the formation of an impermeable surface crust. Removing the mulch and litter layer from NT sharply reduced the infiltration rate. Adding the mulch to CT increased the infiltration rate. The authors concluded that during short-term summer rainfall events, infiltration in conventionally tilled soil is controlled by surface crusting. (Author's abstract)
W88-10646

SOIL HYDROLOGY IN LODGEPOLE PINE ECOSYSTEMS IN SOUTHEASTERN WYOMING,

Wyoming Univ., Laramie. Dept. of Botany.
R. C. Nyberg, and T. J. Fahey.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 3, p 844-849, May/June 1988. 4 fig, 3 tab, 20 ref.

Descriptors: *Pine trees, *Forest soils, *Forest hydrology, *Hydraulic conductivity, *Infiltration, *Soil water, *Leaching, Ecosystems, Spatial distribution, Forest hydrology, Solute transport, Soil porosity, Loam, Sand, Seasonal variations, Snow, Wyoming.

The rates and pathways of water movement through the soil were examined in several lodgepole pine (Pinus contorta ssp. latifolia) forests in southeastern Wyoming to improve our understanding of the dynamics of solute flux in forest ecosystems. We employed internal drainage and tracer-pulse methods to determine hydraulic conductivity, and we examined snowmelt infiltration and drainage water chemistry on contrasting soils supporting lodgepole pine forests. Saturated hydraulic conductivity (K sub 0) values were lognormally distributed for 27 plots at each of two sites examined. The median value was significantly higher at a site on a gravel, loamy-sand (median K sub 0 = 1.20 cm/h) than on a bouldery, sandy-loam (K sub 0 = 0.49). At these sites, the high range in both K sub 0 values and in the transit time for a Cl- pulse were suggestive of highly variable water flow pathways through the soil. Early in the spring snowmelt period, much of the infiltrating water circumvented the soil matrix, probably flowing around entrapped air pockets and through macropores. Although large systemtic differences in chemistry were not observed between soil solutions collected with tension and tensionless lysimeters, saturated flow (collected as drips from the ceiling of soil tunnels) contained about three times lower cation concentrations than the lysimeter solutions. To obtain more accurate estimates of nutrient leaching from the tree rooting zone, better quantification of the chemistry of percolating soil water is needed. (Author's abstract)
W88-10647

NEUTRON MOISTURE METER CALIBRATION IN LARGE DIAMETER BOREHOLES,
Nevada Univ. System, Reno. Water Resources Center.
S. W. Tyler.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 3, p 890-893, May/June 1988. 2 fig, 3 tab, 15 ref. Department of Energy Contract DE-AC08-85NV10384.

Descriptors: *Water content, *Vadose water, *Soil water, *Moisture meters, *Neutron moisture meters, *Calibrations, *Boreholes, Solute transport, Fluctuations, Mathematical equations, Nevada, Laboratories, Alluvial plains, Alluvial soils, Calibration, Monitoring.

In studies of soil moisture flux in the arid, alluvial basins of Nevada, drilling technologies have been developed to easily and economically install 15-cm diam. steel casing to depths of up to 100 m. Laboratory and field calibration of a low source strength (3.7 x 10 to the 8th power Bq or 10 mCi) neutron moisture meter was carried out to determine the impact of such large casing on tool performance. Both laboratory and field tests showed that a quadratic calibration equation relating returned thermal neutron counts to the volumetric water content was acceptable to determine soil profile water content. The density of thermal neutrons returned to the detector was considerably reduced when compared to reported fluxes in traditional small diameter aluminum access pipe. This reduction is attributed to the increased air gap between the tool and the soil, and neutron capture by the steel casing. (Author's abstract)
W88-10648

DESIGN FOR AN AUTOMATED TENSION INFILTROMETER,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 7B.
W88-10649

MICROBIAL DEGRADATION OF ACENAPHTHENE AND NAPHTHALENE UNDER DENITRIFICATION CONDITIONS IN SOIL-WATER SYSTEMS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-10739

DEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBON COMPOUNDS UNDER VARIOUS REDOX CONDITIONS IN SOIL-WATER SYSTEMS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-10740

WATER POTENTIAL GRADIENTS FOR GAPS AND SLOPES IN A PANAMANIAN TROPICAL MOIST FOREST'S DRY SEASON,
Smithsonian Tropical Research Inst., Balboa (Panama).
P. Becker, P. E. Rabenold, J. R. Idol, and A. P. Smith.
Journal of Tropical Ecology, Vol. 4, No. 2, p 173-184, May 1988. 6 fig, 1 tab, 31 ref. NSF Grant BSR-82-14915.

Descriptors: *Drought resistance, *Soil water potential, *Soil-water-plant relationships, *Forest soils, *Tropical regions, *Soil water, Seasonal variation, Plant physiology, Evapotranspiration, Plants, Growth, Tropical forests, Psychrometers, Slopes, Panama.

Soil water potentials were measured weekly by psychrometers at 20 cm depth during the dry season in a tropical moist forest on Barro Colorado Island, Panama. There was a persistent gradient of decreasing soil moisture from gap center to gap edge to adjacent understory at both a large and a small gap. On both a north-south and an east-west transect, the soil was drier (water potentials were more negative) on an upland surface than on moderate slopes. This trend was reflected in the predawn, total water potentials of shallow-rooted Psychotria horizontalis and deep-rooted Trichilia tuberculata measured in the understory during the last two months of the dry season. P. horizontalis from the wettest sites on the transects had higher osmotic potentials at full hydration and at zero turgor, indicating less drought resistance than for conspecifics from the driest sites. (Author's abstract)
W88-10767

HYDRAULIC INVESTIGATIONS OF RUBBLE DRAINS,
For primary bibliographic entry see Field 8B.
W88-10877

MODELING UNSATURATED FLOW IN RECLAIMED LANDS,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
A. Ward, and L. Wells.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 381-403, 17 fig, 4 tab, 31 ref.

Descriptors: *Soil water, *Infiltration, *Unsaturated flow, *Coal mining, *Model studies, Mathematical models, Kentucky, Spoil banks, Mine wastes, Rainfall infiltration, Runoff, Richards equation, Green-Ampt model, Holtan model, Soil Conservation Service curve number method.

A large-scale laboratory infiltrometer system was used to evaluate infiltration and unsaturated flow through profiles constructed from materials obtained from surface coal mines in eastern and western Kentucky. Surface runoff rates were monitored, and transient soil moisture contents were measured with a gamma probe. Tensiometers and laboratory techniques were used to obtain soil moisture/soil suction relationships. Unsaturated hydraulic conductivity relationships were determined using Campbell's method and the zero-flux procedure. An evaluation was made of the Richards equation, the Green-Ampt model, and modified form of Holtan's equation, and the SCS curve number method. The infiltrometer system appeared to be a viable method for measuring infiltration, and the gamma probe provided good estimates of soil properties. Infiltration through the topsoil horizons was typical of agricultural soils, that is, being characterized by high initial rates into the macropores near the surface and later being controlled by surface sealing phenomena which greatly reduced infiltration. The Richards equation numerical model gave the best estimates of infiltration through the different profiles. However, stable solutions were not obtained for the profiles with very dry initial conditions. Results with the Green-Ampt model were only slightly worse. It was deemed applicable to situations where piston-type flow occurred. The Holtan model gave poor estimates of infiltration. The Soil Conservation Service curve number model gave good estimates of the accumulated infiltration volume; however, goodness of fit for individual conditions was essential. (See also W88-10912) (Cassar-PTT)
W88-10932

SIMPLE MODEL FOR TRANSPORT OF FREE-PHASE ORGANICS IN UNSATURATED ZONES OF AQUIFERS,
Colorado Univ., Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 5B.
W88-10933

VERIFICATION OF NUMERICAL MODELS: VARIABLY SATURATED FLOW THROUGH A HETEROGENEOUS MEDIA,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
S. T. Potter, E. B. Ritchie, and R. R. Schnable.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 424-443, 6 fig, 4 tab, 4 ref.

Descriptors: *Hydraulic models, *Soil water, *Saturated flow, *Heterogeneity, Model studies, Mathematical models, Porous media, Finite difference methods, Finite element method, Richards equation, Hydraulic conductivity.

Closed-form steady-state analytical solutions of Richards' equation were developed for horizontal and vertical one-dimensional flow through a heterogeneous variably saturated media. General solutions were derived using an arbitrary set of soil hydraulic equations and subjected to a variety of different boundary conditions. Two specific solutions were presented. These used the Campbell soil hydraulic relationship. These two specific solutions were used to evaluate a series of two finite-difference and four finite-element models. The evaluations helped to assess the overall benefits of each model type and illustrated how different interpretations of hydraulic conductivity at intrinsic changes in media affected model performance. The finite-difference models and the finite-element models with linear bases were more accurate when formulated recognizing that conductivity differs an infinitesimal distance to either side of a media interface. An improved Hermitian interpretation which computes two gradients at nodes located on interfaces between different media was also presented. This formulation was developed with specific discharge and potential, rather than gradient and potential, as the dependent variables. (See also W88-10912) (Cassar-PTT)
W88-10934

EVALUATION OF PRESSURE RELIEF WELL SYSTEM PERFORMANCE USING A NUMERICAL GROUND WATER FLOW MODEL,
Woodward-Clyde Consultants, Overland Park, KS.
For primary bibliographic entry see Field 4B.
W88-10971

DRAINMOD: A WATER TABLE MANAGEMENT SIMULATION MODEL,
Ohio Agricultural Research and Development Center, Wooster. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W88-10978

MOVEMENT OF PESTICIDES AND NUTRIENTS INTO TILE DRAINAGE WATER IN SOUTHEASTERN INDIANA,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W88-11050

HYDROLOGIC SOIL PARAMETERS AFFECTED BY TILLAGE,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
For primary bibliographic entry see Field 4C.
W88-11072

GEOLOGIC AND HYDROGEOLOGIC CHARACTERIZATION OF A HAZARDOUS WASTE DISPOSAL SITE, ARLINGTON, OREGON,
Engineering Enterprises, Inc., Long Beach, CA.
For primary bibliographic entry see Field 5E.
W88-11135

PERCHED WATER IDENTIFICATION WITH RADIATION LOGS,
Washington State Univ., Pullman.
For primary bibliographic entry see Field 2F.
W88-11137

CONTAMINANT EVALUATION OF THE DUWAMISH RIVER VALLEY, SEATTLE, WASHINGTON,
Converse Consultants, Inc., Seattle, WA.
For primary bibliographic entry see Field 5B.
W88-11139

DESIGN OF LYSIMETER LEAK DETECTOR NETWORKS FOR SURFACE IMPOUNDMENTS AND LANDFILLS,
In-Situ, Inc., Laramie, WY.
For primary bibliographic entry see Field 7A.
W88-11141

ESTIMATION OF THE UNSATURATED HYDRAULIC PROPERTIES FOR RESIDUAL SOILS IN A CENTRAL IDAHO WATERSHED,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
P. H. De Groot.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 405-422. 12 fig, 4 tab, 20 ref.

Descriptors: *Soil water, *Estimating equations, *Unsaturated flow, *Hydraulic properties, *Residual soils, Comparison studies, Sand, Hydraulic conductivity, Moisture profiles, Pressure head, Bedrock, Mathematical models, Idaho, Watersheds.

Functional formulations that have been proposed to predict the unsaturated hydraulic properties of porous media were compared to actual data obtained by the U. S. Forest Service. The data originated in the Pine Creek Hydrology Study Area located in central Idaho. The soils located within this high elevation watershed consist of a loamy coarse sand overlying a moderately weathered and fractured granitic bedrock. The saturated conductivity and moisture content-pressure head relationships for each of the layers and the bedrock were experimentally determined. Those data were used as a basis for comparison of several published functional formulations, used to predict the moisture content-pressure head relationships and moisture content-relative hydraulic conductivity relationships. The predictive ability of each formulation was evaluated by both graphical and statistical comparison. The advantages and disadvantages of employing each formulation is discussed. One of these formulations was found to be able to successfully predict the unsaturated hydraulic properties for the soils found in this watershed. (See also W88-11121) (Author's abstract)
W88-11142

ESTIMATING AIR, WATER AND HYDROCARBON CONDUCTIVITY OF SOILS FROM FIELD MEASURABLE PROPERTIES,
Soil and Material Engineers, Cincinnati, OH.
G. R. Koerner, J. P. Martin, and P. H. De Groot.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 423-440. 9 fig, 5 tab, 16 ref. NSF Environmental Engineering Program Project ECE 8416162.

Descriptors: *Path of pollutants, *Hydraulic conductivity, *Mathematical models, *Soil physical properties, *Hydrocarbons, *Gasoline, *Oil, *Permeability, Soil tests, Soil water, Saturated flow, Model testing, Sand, Estimating equations, Air-earth interfaces.

This paper describes a study of single-phase (saturated) conductivities of clean granular soil to different fluids. The program included investigation of the effects of gradation and relative density, on conductivity of air, water, gasoline, kerosene and motor oil. For each set of tests, a bank of permeameters were dynamically packed to a target void ratio or porosity with a quartz sand of specific uniformity, coarseness, and texture. Each specimen was permeated with a different fluid, after being checked for replicability with an air conductivity procedure. This process was repeated in some degree for seven soils, and at four values of relative densities for each. The results were then analyzed to determine the accuracy of the Nutting (intrinsic permeability), Hazen (effective size) and Kozeny-Carman Equations. The results show that conversions from water to immiscible product conductivity done by extracting the intrinsic permeability are most valid for Newtonian fluids with dynamic viscosities similar to water, and less accurate for other fluids, with up to a half-order of magnitude error. In comparing the hydraulic conductivities of different soils as estimated with the simple Hazen formula, the dominance of the effective size on conductivity was shown, but neglect of porosity or density effects could also produce a large error. The most accurate prediction of intrinsic permeability was with the Kozeny-Carman equation, using average values of hard to measure parameters such as tortuosity and shape factor. Soil and formation properties such as gradation, particle shape and relative density are easily measured and dominate behavior. (See also W88-11121) (Author's abstract)
W88-11143

SUBSURFACE TRANSPORT OF GASOLINE-DERIVED LEAD AT A FILLING-STATION CONTAMINATION SITE IN YAKIMA, WASHINGTON,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W88-11149

IRRIGATION IMPACT ISSUES AT THE PROPOSED GRANT COUNTY WASTE MANAGEMENT SITE,
Hart Crowser, Inc., Seattle, WA.
For primary bibliographic entry see Field 5E.
W88-11150

SMALL SCALE RECOVERY OF HYDROCARBONS IN GROUND WATER: A CASE STUDY,
Smith (Roger N.) Associates, Inc., Portland, OR.
For primary bibliographic entry see Field 5G.
W88-11155

REMEDIATION AT A MAJOR SUPERFUND SITE, WESTERN PROCESSING, KENT, WASHINGTON,
HDR Infrastructure, Inc., Seattle, WA.
For primary bibliographic entry see Field 5G.
W88-11157

FACILITATED TRANSPORT OF NAPHTHALENE AND PHENANTHRENE IN A SANDY SOIL COLUMN WITH DISSOLVED ORGANIC MATTER - MACROMOLECULES AND MICELLAS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W88-11219

DEVELOPMENT AND EXPERIMENTAL VERIFICATION OF A MODEL FOR TRANSPORT OF CONCENTRATED ORGANICS IN THE UNSATURATED ZONE,
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W88-11220

RAPID ASSESSMENT MODEL FOR SPILLS ON SOIL OF OILY FLUIDS THAT ARE IMMISCIBLE WITH WATER,
Canviro Consultants Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 5A.
W88-11221

KINETIC INTERACTION OF NEUTRAL TRACE LEVEL ORGANIC COMPOUNDS WITH SOIL ORGANIC MATERIAL,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W88-11222

VADOSE ZONE LITHOLOGICAL INFLUENCES ON LIQUID HYDROCARBON TRANSPORT AND PLUME DELINEATION,
Delaware State Dept. of Natural Resources and Environmental Control, Dover.
For primary bibliographic entry see Field 5B.
W88-11224

SIMULATION OF THE MOVEMENT OF VOLATILE ORGANIC VAPOR THROUGH THE UNSATURATED ZONE AS IT PERTAINS TO SOIL-GAS SURVEYS,
Hydrosystems, Inc., Falls Church, VA.
For primary bibliographic entry see Field 5B.
W88-11226

SOIL VENTILATION FOR THE REMOVAL OF ADSORBED LIQUID HYDROCARBONS IN THE SUBSURFACE,
Groundwater Technology, Inc., Norwood, MA.
For primary bibliographic entry see Field 5G.
W88-11252

PROGRAMMING A HILLSLOPE WATER MOVEMENT MODEL ON THE MPP,
Science Applications Research, Lanham, MD.
J. E. Devaney, A. R. Irving, P. J. Camillo, and R. J. Gurney.
IN: Frontiers of Massively Parallel Scientific Computation. Proceedings of the First Symposium Sponsored by the National Aeronautics and Space Administration and the Goodyear Aerospace Corporation, NASA Goddard Space Flight Center, Greenbelt, Maryland, September 24-25, 1986. NASA Conference Publication 2478, July 1987. p 19-26, 9 ref. NASA Contract NAS5-28200.

Descriptors: *Computer programs, *Model studies, *Infiltration, *Groundwater movement, *Streamflow, Hydrologic models, Evaporation, Slopes, Unsaturated flow, Flow discharge, Soil water, Rainfall-runoff relationship.

A physically based numerical model of heat and moisture flow within a hillslope on a parallel architecture computer was developed, as a precursor to a model of a complete catchment. Moisture flow within a catchment includes evaporation, overland

flow, flow in unsaturated soil, and flow in saturated soil. Because of the empirical evidence that moisture flow in unsaturated soil is mainly in the vertical direction, flow in the unsaturated zone can be modelled as a series of one-dimensional columns. This initial version of the hillslope model includes evaporation and a single column of one-dimensional unsaturated zone flow. This case has already been solved on an IBM 3081 computer and is now being applied to the MPP architecture so as to make the extension to the one-dimensional case easier and to check the problems and benefits of using a parallel-architecture machine. (Author's abstract)
W88-11265

2H. Lakes

MEIOBENTHOS OF A LAKE CHAIN AFFECTED BY PULP MILL EFFLUENT,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10113

DEVELOPMENT OF FLOATING PEAT AND MACROPHYTE VEGETATION IN A NEWLY CREATED, POLYHUMIC RESERVOIR, WESTERN FINLAND,
Water and Environment District of Vaasa, Vaasa (Finland).
E. Koskenniemi.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 165-173, 1987. 5 fig, 2 tab, 23 ref.

Descriptors: *Vegetation establishment, *Plant populations, *Aquatic plants, *Peat, *Succession, *Reservoirs, Species composition, Macrophytes, Decomposition, Finland.

Floating peat and macrophyte development were studied in the Kyrkosjarvi reservoir (6.4 sq km, mean depth = 2.5 m) since its initial filling in the spring of 1981 to 1986. The amount of the floating peat (lifted up by bacterial decomposition gases) was divided about 50/50 between drifting and attached types. It became very wide spread in the third year and reached its maximum (altogether 11.2% of the reservoir area) in the fourth summer, being as common also in later years (1985-86). Vegetation developed on, and along the 'shores' of, the quite solid attached peat, while the floating type is prognosticated to disappear with aging of the reservoir. The vegetation succession divided into three phases. During the first year, there was a mass occurrence of filamentous green algae on the shallows (1st phase) followed by a dense occurrence of freely-floating stands of Callitriche palustris L. (2nd phase, 2nd and 3rd year). Later on, the water mosses (Drepanocladus, with D. procerus (Renn. and H.Arn.) Warnst. as a dominating species) and the stands of Sparganium emersum Rehman became abundant on the shallow natural shores (3rd phase, 4th to 6th year). The species number of macrophytes (12 in 1986) stayed very low because of unfavorable conditions to many species. The Drepanocladus stands seem to be a very stationary element in the reservoir being able to resist regulation conditions on shallow organic shores. (Author's abstract)
W88-10122

RELATIONS BETWEEN PLANKTIC BLUE-GREEN ALGAL DYNAMICS AND ENVIRONMENTAL FACTORS IN FOUR EUTROPHIC SWEDISH LAKES,
Moi Univ., Eldoret (Kenya). Dept. of Wildlife Management.
L. Ramberg.
Archiv fuer Hydrobiologie AHYBA4, Vol. 112, No. 2, p 161-175, April 1988. 4 fig, 3 tab, 28 ref.

Descriptors: *Phytoplankton, *Population dynamics, *Limnology, *Solar radiation, *Nutrients, *Eutrophic lakes, *Cyanophyta, *Algae, *Lakes, Ecology, Plant population, Phosphates, Light penetration, Sweden.

Eighteen blue-green algal populations were studied in 4 eutrophic lakes over a four-month period. The increase and decrease of vegetative cells, akinetes and heterocysts were analyzed against environmental factors. Changes in the effective light climate, the concentration of phosphate phosphorus and inorganic nitrogen had statistically significant correlations with variations in the number of different kinds of blue-green algal cells. The findings, in particular those for the nutrients, are in agreement with physiological results while the complex relations between the effective light climate and the blue-green algal dynamics are new observations. (Author's abstract)
W88-10127

FIRST STEPS TO PERIPHYTON,
Agricultural Univ., Wageningen (Netherlands). Dept. of Plant Cytology and Morphology.
J. H. Otten, and M. T. M. Willemse.
Archiv fuer Hydrobiologie AHYBA4, Vol. 112, No. 2, p 177-195, April 1988. 8 fig, 8 tab, 46 ref.

Descriptors: *Epiphytes, *Vegetation establishment, *Substrates, *Algal growth, *Succession, *Algae, Plant populations, Wettability, Plant morphology, Vegetation regrowth, Aquatic environment.

Experiments were carried out in order to quantify the influence of substrate wettability and surface charge of glass, plexiglass and polylysine coated glass on the attachment strength of some freshwater algae. It appears that these physical substrate characteristics are important factors involving in periphyton formation, but their influence is merely temporary. In adhesion of Nitzschia palea the influence of temperature is shown, and in adhesion of Scenedesmus sp. the nitrate content of the medium appeared to be an important factor. Attachment strength of algae that colonized glass slides in a pond is determined experimentally by washing of the substrates and by ultrasonic treatment. Exposure to waterflow, streamline, mucilage composition and attachment structures are important in algal adhesion. In the case of diatoms, three basic attachment systems, based upon morphological criteria, are distinguished. Succession stages of periphyton on Cladophora crispata threads are studied and coupled to the growth pattern of the threads. Physiological activity of the Cladophora cells seems to be one important factor that characterizes the composition of the epiphyton. (Author's abstract)
W88-10128

MICROBIAL INVESTIGATIONS IN RIVERS: VII. SEASONAL VARIATIONS OF BACTERIAL NUMBERS AND ACTIVITY IN EUTROPHIED RIVERS OF NORTHERN GERMANY,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 5C.
W88-10129

STRUCTURE AND DYNAMICS OF THE PHYTOPLANKTON ASSEMBLAGES IN LAKE VOLVI GREECE: I. PHYTOPLANKTON COMPOSITION AND ABUNDANCE DURING THE PERIOD MARCH 1984-MARCH 1985.
Thessaloniki Univ., Salonika (Greece). Inst. of Botany.
M. T. Moustaka-Gouni.
Archiv fuer Hydrobiologie AHYBA4, Vol. 112, No. 2, p 251-264, April 1988. 4 fig, 4 tab, 34 ref.

Descriptors: *Limnology, *Species composition, *Aquatic populations, *Phytoplankton, *Population dynamics, Seasonal variations, Ecology, Biomass, Lakes, Aquatic environments, Greece.

Qualitative and quantitative analyses of phytoplankton in Lake Volvi, Northern Greece were carried out during the period March 1984 to March 1985. One-hundred twenty-two taxa have been identified. The biomass of the phytoplankton is dominated by three groups: Bacillariophyceae, Cryptophyta and Cyanophyta. The monthly values of phytoplankton biomass ranged between 840-2843 mg/cu m. Small differences were found in the horizontal distribution of the phytoplankton. A comparison was made between the species composition of the phytoplankton from Lake Volvi characterized by Cyanophyta and those from other lakes in Greece dominated by diatoms. (Author's abstract)
W88-10131

SUBLITTORAL EROSION OF UNTERSEE (LAKE CONSTANCE). LATE CONSEQUENCES OF EUTROPHICATION AND HYDROLOGICAL PHENOMENA,
Konstanz Univ. (Germany, F.R.). Inst. fuer Seenforschung und Fischereiwesen.
For primary bibliographic entry see Field 5C.
W88-10132

FIELD EVIDENCE FOR HYDRAULIC JUMPS IN SUBAQUEOUS SEDIMENT GRAVITY FLOWS,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W88-10159

ECOLOGICAL CHARACTERISTICS OF SESSILE ALGAL COMMUNITIES IN THE OLCZYSKI STREAM (TATRA MTS, POLAND) WITH SPECIAL CONSIDERATION OF LIGHT AND TEMPERATURE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
B. Kawecka.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 3, p 299-310, 1985. 2 fig, 2 tab, 15 ref.

Descriptors: *Diatoms, *Mountain streams, *Temperature effects, *Light intensity, Ecology, Poland, Olczyski, Stream, Algae.

The shade thrown by a bridge and the inflow of water from a natural hot spring were used in an investigation of the reaction of algae to changes in light intensity and temperature. Hydrurus foetidus, Homoeothrix janthina, and Ceratoneis arcus were sensitive to light deficiency, whereas Chantransia pygmea, Amphora ovalis var. pediculus and Achnanthes lanceolata grew in the shade. Rhoicosphenia curvata, Cocconeis placentula var. euglypta, Navicula gracilis grew in shade and at raised temperature. The species Achnanthes minutissima, A. pyreneica, Cymbella ventricosa, species of the Gomphonema and Diatoma hiemale with the variety mesodon had a wide spectrum with regard to light. (Author's abstract)
W88-10172

DIATOM COMMUNITIES IN SOME STREAMS OF SOUTHERN GREENLAND,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
B. Kawecka, and J. W. Leo.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 3, p 311-319, 1985. 2 fig, 18 ref.

Descriptors: *Ecology, *Diatoms, *Glacial stream, *Snowmelt, Biomass, Nutrients, Algae, Greenland.

The structure of diatom communities developing in streams which flow out of a melting glacier and from snowfields of Southern Greenland is described. Tabellaria flocculosa, Achnanthes nodosa, A. rupestris, Anomoeoneis serians var. brachysira and Eunotia polydentula developed the largest populations. The index of diatom biomass was low. Lack of sufficient nutrients is suggested as the reason for poor diatom community development in these glacial streams. (Miller-PTT)
W88-10173

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 4. ATMOSPHERIC HEAVY METAL POLLUTION OF THE BOTTOM OF THE RESERVOIR AT KOZLOWA GORA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.

For primary bibliographic entry see Field 5B.
W88-10180

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 8. CILIATA IN BOTTOM SEDIMENTS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10184

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 11. ICHTHYOFAUNA OF THE RESERVOIR AT KOZLOWA GORA AND LAKE CHECHLO-NAKLO,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10187

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 12. SYNTHETIC OUTLINE OF INVESTIGATION RESULTS AND CONCLUSIONS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10188

BENTHIC COMMUNITIES IN BRACKISH LAKES IN HOKKAIDO, WITH SPECIAL REFERENCE TO RELATIONSHIPS BETWEEN SERIES OF COMMUNITY TYPES AND ENVIRONMENTAL FACTORS, (IN JAPANESE),
Hokkaido Univ., Hakodate (Japan). Faculty of Fisheries.
Y. S. Li, and S. Nakao.
Hokkaido University. Faculty of Fisheries Bulletin, Vol. 36, No. 1, p 12-27, 1985. 13 fig, 4 tab, 17 ref (English summary).

Descriptors: *Japan, *Brackish water, *Lakes, *Fauna, *Benthos, *Lake sediments, Benthic fauna, Hokkaido, Cluster analysis, Salinity, Limnology, Interstitial waters.

Pankenuma and Poronuma are small brackish lakes located on the Japan Sea coast and the Okhotsk Sea coast in northern Hokkaido, respectively. Mokotoko is a similar lake located on the north coast of Shiretoko Peninsula in eastern Hokkaido. A survey of bottom fauna and bottom environmental factors of these lakes was carried out in July and August 1983. Macro benthos were collected using a small Smith-McIntyre's bottom sampler with an opening of 1/20 sq m. Sampling was repeated twice and benthos in an area of about 1/10 sq m were obtained at each station. Based upon the findings of a cluster analysis, two different communities are distinguished in Poronuma and three in Pankenuma and Mokotoko. In Pankenuma and Poronuma, with a gentle environmental gradient, the benthic communities are continuous. But in Mokotoko, with a steep environmental gradient, the communities are distinctly discontinuous. One community is restricted to the central part of (muddy bottom with a higher proportion of sedimentological variables) and the other two similar communities are detected in the shallow coastal area (sandy bottom with a lower proportion of sedimentological variables). The benthic communities of the three brackish lakes are divided into six types according to the results of the cluster analysis. These six community types are arranged according to the contents of interstitial water chlorinity but the distribution of these community types scarcely runs parallel with those of bottom water chlorinity and sedimentological variables. (Author's abstract)
W88-10189

SEPTIC TANKS AS SOURCES OF PHOSPHORUS TO LOUGH ERNE, IRELAND,
University Coll., London (England). Palaeoecology Research Unit.
For primary bibliographic entry see Field 5B.
W88-10199

ENVIRONMENTAL STRUCTURES IN THE RIVER MOUTH SYSTEMS OF THE CENTRAL ZONE OF CHILE (V REGION) (ESTRUCTURAS AMBIENTALES IN LOS SISTEMAS DE DESEMBOCADURA DE RIOS Y ESTEROS DE LA ZONA CENTRAL DE CHILE (V REGION)),
Universidad de Valparaiso (Chile). Inst. de Oceanologia.
G. Leighton, E. Lobo, and R. Ugarte.
Revista de Biologia Marina (Valparaiso), Vol. 23, No. 2, p 139-157, December 1987. 6 fig, 5 tab, 8 ref (English summary).

Descriptors: *Lotic environment, *Aquatic habitats, *River mouth, Chemical properties, Physical properties, Sandbar estuaries, Statistical analysis, Multivariate analysis, Chile, Hydrogen ion concentration, Temperature, Oxygen, Nutrients, Alkalinity, Salinity.

In order to characterize the environmental structures in the river mouth systems of the Central zone of Chile, yield samplings were made in three periods of the year: November 1982, January 1983 and April 1983. The physical and chemical properties of the principal channel (i.e., water temperature and transparency, oxygen concentration, phosphate, nitrite, alkalinity, chlorinity and pH) were determinated. (Author's abstract)
W88-10200

SEASONAL VARIATION IN THE ABUNDANCE AND HETEROTROPHIC ACTIVITY OF SUSPENDED BACTERIA IN TWO LOWLAND RIVERS,
Hull Univ. (England). Dept. of Plant Biology.
R. Goulder.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 21-37, February 1986. 6 fig, 3 tab, 63 ref.

Descriptors: *Rivers, *Aquatic bacteria, *Seasonal variation, *Population dynamics, *Heterotrophic bacteria, *Stream biota, Bacterial analysis, Regression analysis, Lotic environment, Turnover time, Particulate matter, Water sampling, Yorkshire Ouse River, Yorkshire Derwent River, England, Factor analysis, Bacteria.

Water samples were collected over two years from the Yorkshire Ouse and Yorkshire Derwent Rivers and the following were measured: (1) concentration of directly-counted bacteria (free-living and particle-bound), (2) concentration of colony-forming units, (3) bacterial heterotrophic activity (turnover rate for glucose assimilation), (4) specific activity (turnover rate per bacterium), and (5) a range of environmental variables. The abundance and activity of suspended bacteria showed similar seasonal periodicities in both rivers. Free-living bacteria were usually more numerous than particle-bound bacteria; low concentration of free-living bacteria and maxima of particle-bound bacteria usually occurred in winter. The concentrations of colony-forming units varied irregularly, but the lowest levels were found in summer. In addition, turnover rate and turnover rate per bacterium showed distinct summer maxima. Multiple-regression analysis was used to relate bacterial variables to subsets (chosen by factor analysis) of environmental variables; up to 89% of variation in bacterial variables was related to the combined effects of variation by variables in the chosen subsets. (Author's abstract)
W88-10202

RATES OF AMMONIA RELEASE FROM SEDIMENTS BY CHIRONOMID LARVAE,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
I. Tatrai.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 61-66, 5 fig, 1 tab, 15 ref.

Descriptors: *Limnology, *Lakes, *Cycling nutrients, *Sediments, *Nitrogen, *Midges, *Ammonia, *Eutrophication, Sediment-water interfaces, Temperature effects, Mineralization, Nitrogen-phosphorus ratio, Aeration, Temperature, Benthos, Limnology, Balaton Lake, Hungary, Metabolism, Excretion, Microcosms.

Microcosms of Lake Balaton (Hungary) mud or sterilized sand and aerated water were used to evaluate ammonia increments in the overlying water as influenced by chironomid density and temperature. In the two approaches, the effects of sediment disturbance and metabolic excretion of chironomids were measured. The activity of larvae increased the ammonia content of the overlying water at temperatures above 10 C. A rise of temperature to 20 C resulted in a 5- to 20-fold increase in ammonia release in both systems with chironomids. At 10 C, combined effects of sediment disturbance and excretion produced lower release rates than did excretion rates alone (mud-water vs. sand-water treatments). At higher temperatures (15 C and 20 C), release rates of ammonia by sediment disturbance + excretion were higher than excretion rates alone. Ammonia excretion contributed significantly to the total release at each temperature. Metabolic mineralization of nitrogen compounds appears to be an important mechanism contributing to nitrogen regeneration from aerobic lake sediments. The high N:P ratio (14:1) of chironomid excreta supports this interpretation. (Author's abstract)
W88-10203

SPATIAL AND TEMPORAL VARIATION IN THE MACROINVERTEBRATE FAUNA OF STREAMS OF THE NORTHERN JARRAH FOREST, WESTERN AUSTRALIA: COMMUNITY STRUCTURE,
Western Australia Univ., Nedlands. Dept. of Zoology.
S. E. Bunn, D. H. Edward, and N. R. Loneragan.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 67-91, 12 fig, 7 tab, 54 ref, append.

Descriptors: *Seasonal variation, *Macroinvertebrates, *Forests, *Ecological distribution, *Rivers, *Community structure, *Temperature effects, Geology, Western Australia, Jarrah forest, Spatial distribution, Temporal distribution, Temperature, Regression analysis, Discriminant analysis, Statistics, Multivariate analysis, Lotic environment, Classification, Ordination, Limnology, Dissolved oxygen, Hydrogen ion concentration, Cations, Species diversity, Water temperature, Catchment areas, Stream discharge.

Streams of the northern jarrah forest, Western Australia, were sampled at 12 sites from December 1981 to December 1982 to examine spatial and temporal changes in the structure of the macroinvertebrate community. The climate of this region is quite predictable by Australian standards; each year a hot, dry summer is followed by a mild, wet winter. Highest stream discharge occurs during winter (June-November), reducing to negligible flow over late summer and autumn (January-May). The low flows in summer were associated with warm water, lower dissolved oxygen, increased concentrations of cations, and, in many cases, pH. Temporal changes in abundance, diversity, and evenness indicated that the invertebrate fauna became dominated by a few taxa during the summer months. Major spatial and temporal changes in the composition of the fauna were detected by classification and ordination. Summer and winter faunas were identified at most sites and were clearly associated with the seasonal changes in the physical and chemical environment. This seasonality is not typical of stream systems previously studied in Australia. Large spatial differences also occurred over small distances among sites in two similar-sized forested catchments. Multiple discriminant analysis and stepwise multiple regression analysis showed that velocity and depth were highly associated with the observed temporal changes in the fauna, though other variables, including cation concentrations and water temperature, also were important. Spatial differences were correlated with concentrations of cations, which may reflect differences in the geologies of the catchments. (Author's abstract)

W88-10204

PEAT AND PEAT WATER CHEMISTRY OF A FLOOD-PLAIN FEN IN BROADLAND, NORFOLK, U.K.,

Sheffield Univ. (England). Dept. of Botany.
K. E. Giller, and B. D. Wheeler.

Freshwater Biology FWBLAB, Vol. 16, No. 1, p 99-114, 8 fig, 3 tab, 38 ref.

Descriptors: *Limnology, *Wetlands, *Peat, *Fens, *Flood plains, *Trophic level, *England, *Flooding, *Cycling nutrients, Sphagnum, Density, Soil water, Time series analysis, Estuarine clays, Nitrogen, Phosphorus, Clays, Cation exchange, Brackish water, Saline water intrusion, Seasonal variation, Broadland, Norfolk, Macrophytes, Bog plants, Tidal rivers, Tidal effects, Peat water, Rivers, Estuaries, Chemical properties, Ions.

Dominant chemical gradients in the peats of a floodplain fen in Broadland, Norfolk, were poor-fen (oligotrophic) <--> rich-fen (minerotrophic) and freshwater <--> brackish water. These gradients were to some extent obscured by a complex of factors governing the concentrations of ions in the peats and peat waters. The peats were almost totally organic and cation exchange capacities (CECs) varied with their macrofossil composition. Cladium mariscus L. peats had higher CEC than Phragmites communis Trin. peats of similar bulk density. Amounts of dissolved and extractable N and P were very low, but total amounts of N and P were high and closely related to bulk density. Large seasonal variation in concentrations of ions in the peat waters was due to dilution at times of flooding. There was strong evidence that little river water penetrated directly across the study area, contrary to classical descriptions of floodplain mires. Amplitude of fluctuations in concentration varied between study sites, but the pattern of change was similar. Fluctuations were small in poor-fen, Sphagnum-dominated sites. An incursion of brackish water up river due to unusually high tides was observed, but it is likely that brackish conditions in the fens are caused by release of ions from underlying estuarine clays. (Author's abstract)
W88-10205

MICROHABITAT SELECTION BY A STREAM-DWELLING AMPHIPOD: A MULTIVARIATE ANALYSIS APPROACH,

Toronto Univ. (Ontario). Div. of Life Sciences.
D. D. Williams, and K. A. Moore.

Freshwater Biology FWBLAB, Vol. 16, No. 1, p 115-122, 3 fig, 3 tab, 17 ref.

Descriptors: *Gammarus, *Amphipods, *Aquatic habitats, *Particle size, *Microhabitats, *Lotic environment, Silt, Gravel, Food habits, Behavior, Streams, Water currents, Colonization, Artificial substrates, Ontario, Habitats, Rivers, Interstitial spaces, Deposition, Sediments, Analysis of covariance.

Colonization of microhabitat implants by the amphipod Gammarus pseudolimnaeus in a small southern Ontario stream was studied to analyze the factors controlling habitat selection. The variables substrate particle size, current speed, presence of food, and light were used in an analysis of covariance, with percentage weight of organic matter of silt and percentage interstitial space occluded by silt as the covariates. Greatest numbers of amphipods settled on microhabitats featuring large substrate particles, no current, and the presence of food. There also was a positive relationship between total numbers and the volume of silt deposited on the microhabitats by the stream; small quantities of silt had a beneficial effect on colonization but larger quantities became detrimental. The change from a positive effect occurred at approximately 25% occlusion of the interstitial space in large gravel (mean diameter = 3.2 cm) and at approximately 55% occlusion in small gravel (mean diameter = 0.34 cm). Large animals (6-16.0 mm long) were found predominantly in microhabitats featuring food and large substrate. Medium-sized animals (3-6.0 mm) were most commonly associated with no current and presence of food, and were positively affected by the amount of silt but, at the same time, were negatively affected by increasing occlusion of interstitial spaces by silt. Numbers of small Gammarus (less than 3.0 mm) were affected only by silt and in a similar manner to medium-sized animals. Amphipod biomass was greatest in microhabitats featuring food and no current. Previous data on the behavior of this species in laboratory stream-tanks are compared with the microhabitat selections seen. (Author's abstract)
W88-10206

STREAM HYDRAULICS AS A MAJOR DETERMINANT OF BENTHIC INVERTEBRATE ZONATION PATTERNS,

Karlsruhe Univ. (Germany, F.R.). Zoologisches Inst.
B. Statzner, and B. Higler.

Freshwater Biology FWBLAB, Vol. 16, No. 1, p 127-139, 8 fig, 1 tab, 67 refs.

Descriptors: *Lotic environent, *Hydraulic profiles, *Streams, *Aquatic habitats, *Benthic invertebrates, *Ecological distribution, *Environmental gradient, *Stream profiles, *Water currents, Comparison studies, Habitats, Rivers, Headwaters, Deltas, Estuaries, Ecological stability, Limnology, Physical properties, Ecosystems, Hydraulics, Benthos, Spatial distribution, Zones.

Studies on the zonation of benthic fauna of fourteen streams situated in a variety of latitudes from Alaska to New Zealand were evaluated. The authors suggest that physical characteristics of flow ('stream hydraulics') are the most important environmental factor governing the zonation of stream benthos on a worldwide scale. From the source to the mouth of a stream, zones of transition in 'stream hydraulics' occur, to which the general pattern of stream invertebrate assemblages can be related. In these zones benthic community stability and resilience must be different from those upstream and downstream of the hydraulic transition zones. A general faunistic zonation pattern for the benthos in pristine streams is proposed based on the changes in flow characteristics from headwaters to delta (or estuary) in a 'standard' stream. (Rochester-PTT)
W88-10207

PHOSPHORUS INACTIVATION IN A EUTROPHIC LAKE BY THE DIRECT ADDITION OF FERRIC ALUMINIUM SULPHATE: CHANGES IN PHYTOPLANKTON POPULATIONS,

Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
R. H. Foy, and A. G. Fitzsimons.

Freshwater Biology FWBLAB, Vol. 17, No. 1, p 1-13, February 1987. 9 fig, 4 tab, 24 ref.

Descriptors: *Lake restoration, *Phosphorus removal, *Eutrophic lakes, *Plant populations, *Population dynamics, *Oscillatoria, *Algae, Seasonal variation, Sulfates, Iron compounds, Aluminum sulfate, Daphnia, Diatoms, Carotenoids, White Lough, Flocculation, Ferric aluminum sulfate, Phytoplankton, Alum.

Reduced total phosphorus concentrations in the summer which followed the addition of iron aluminum sulfate to White Lough failed to reduce significantly the phytoplankton, which continued to be dominated by Oscillatoria agardhii var. isothrix Skuja. This species was present throughout the 4 years studied, forming over 50% of the algal volume in 80% of samples. In contrast, species which occurred principally in the summer months were found to be severely curtailed when sediment release of phosphorus was suppressed. The phosphorus:carotenoid ratio was used to assess the extent of phosphorus limitation because laboratory studies on O. agardhii var. isothrix showed that this ratio was a much better indicator of cell phosphorus content than the phosphorus:chlorophyll a ratio. Reduced summer phosphorus concentrations in White Lough caused a transition from intermittent to continuous phosphorus limitation rather than a proportional reduction in the summer phytoplankton. Reduced autumn grazing pressure by Daphnia hyalina Leydig allowed a large algal population to develop in the winters following phosphorus reduction despite a 50% decline in total phosphorus. The combination of increased winter phytoplankton and lower total phosphorus reduced soluble reactive phosphorus concentrations to less than 5 micrograms P/L which in turn curtailed the spring diatom pulse. (Author's abstract)
W88-10208

SOURCES OF THE LIPIDS IN THE BOTTOM SEDIMENTS OF AN ENGLISH OLIGO-MESOTROPHIC LAKE,

Bristol Univ. (England). Organic Geochemistry Unit.
N. Robinson, P. A. Cranwell, and G. Eglinton.

Freshwater Biology FWBLAB, Vol. 17, No. 1, p 15-33, February 1987. 8 fig, 5 tab, 58 ref. Natural Environment Res. Council grants GR3/2951 and GR3/3758.

Descriptors: *Lipids, *Bottom sediments, *Oligotrophic lakes, *Mesotrophic lakes, *Geochemistry, *Diagenesis, Microbial degradation, Organic matter, Coniston Water, English Lake, England, Cycling nutrients.

The organic geochemistry of Coniston Water, a low productivity lake, was investigated. The relative inputs of the various known sources to different compound classes suggest terrestrial higher plants as the major source of sedimentary organic matter. Early lipid diagenesis, proceeding in the bottom sediments as a result of microbial activity, produces relatively rapid changes, with shorter chain and unsaturated compounds being preferentially degraded. Free and bound (acid liberated) lipids exhibit significant differences in composition, related to their respective sources and stability towards degradation. The lipid composition of an aquatic higher plant (E lodea nuttallii), growing in the margins of the lake, has been determined; comparison with the sedimentary lipids revealed it not to be a significant source. (Author's abstract)
W88-10209

PREDICTION OF THE MACRO-INVERTEBRATE FAUNA OF UNPOLLUTED RUNNING-WATER SITES IN GREAT BRITAIN USING ENVIRONMENTAL DATA,

Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
D. Moss, M. T. Furse, J. F. Wright, and P. D. Armitage.

Freshwater Biology FWBLAB, Vol. 17, No. 1, p 41-52, February 1987. 2 fig, 7 tab, 33 ref.

Descriptors: *Prediction, *Macroinvertebrates, *Running waters, *Lotic environment, *Probability distribution, *Stream biota, Estimating equations, Data interpretation, Chemical properties, Physical properties, Stream pollution, Mathematical studies, Statistical analysis, Pollution index, Great Britain.

A procedure employing TWINSPAN (two-way indicator species analysis) has been developed which uses environmental data to predict the probabilities of macro-invertebrate taxa occurring at running-water sites in Great Britain. Biological, physical and chemical data were collected from twenty-one sites on three river systems in order to evaluate the procedure. For most sites the number and type of taxa recorded, using a standard sampling program, were very close to those predicted using twenty-eight environmental variables. These variables include topographical parameters, water channel size and dynamics, particle sizes, macrophyte cover, and chemical data such as pH, dissolved oxygen, and alkalinity. Comparison with other studies at the same sites showed that most taxa whose probability of occurrence was > or = to 0.5 could be found with more intensive sampling. Reducing the number of variables used in making the predictions from twenty-eight to five resulted in only a slight loss of productive accuracy. Combinations of chemical and physical variables gave better predictions than equivalent numbers of physical variables only but the latter may

be more appropriate where chemical pollution is known, or suspected to occur. The procedure is of practical value in the detection and assessment of pollution. It may also be used to explore patterns in the structure and functioning of stream communities. (Author's abstract)
W88-10210

COLONIZATION OF RIVERS AND CANALS IN GREAT BRITAIN BY DUGESIA TIGRINA (GIRARD) (PLATYHELMINTHES: TRICLADIDA),
Freshwater Biological Association, Wareham (England). River Lab.
R. F. Wright.
Freshwater Biology FWBLAB, Vol. 17, No. 1, p 69-78, February 1987. 1 fig, 2 tab, 16 ref, append.

Descriptors: *Dugesia, *Rivers, *Ecology, *Population dynamics, *Colonization, *Canals, *Exotic species, *Lotic waters, *Distribution patterns, Spatial distribution, Great Britain, Aquatic habitats.

Prior to 1975 Dugesia tigrina, an American immigrant triclad, was known from only a few flowing water sites in Great Britain. Since then it has been found in a large number of lowland rivers and canals in England and Wales, and in 1985 it was reported from the lower reaches of the River Tweed in Scotland. The recorded distribution of D. tigrina up to the end of 1985 (115, 10 km squares now occupied) is reported and the environmental conditions are summarized at a subset of twenty-five sites where D. tigrina occurs. Information on the native triclads at sites recently colonized by D. tigrina is used as a basis for speculating on the rivers most vulnerable to the future spread of this species. Possible methods of dispersal of D. tigrina, most likely via human activities, are discussed. The features which make D. tigrina a successful colonist are its ability to exploit a wide variety of food resources, its asexual mode of reproduction and high potential for population growth, and its physiological tolerance of enriched waters, high water temperatures and brackish water. (Author's abstract)
W88-10211

IMPACT OF PLANKTIVOROUS FISH ON THE STRUCTURE OF A PLANKTON COMMUNITY,
York Univ., North York (Ontario). Dept. of Biology.
J. R. Post, and D. J. McQueen.
Freshwater Biology FWBLAB, Vol. 17, No. 1, p 79-89, February 1987. 6 fig, 2 tab, 24 ref.

Descriptors: *Planktivorous fish, *Plankton, *Eutrophic lakes, *Algal control, *Perch, Population dynamics, Crustaceans, Daphnia, Population density, Aquatic productivity, Zooplankton, Phytoplankton, Biomass, Fish food organism, Limnology, Lake management.

The abundance of planktivorous juvenile yellow perch, Perca flavescens, was manipulated in three 750 cu m enclosures in a eutrophic lake. There was a significant negative relationship between fish and zooplankton biomasses. At high fish densities the zooplankton community was dominated by large filter-feeding cladocera, primarily daphnids. There was no significant relationship between zooplankton and phytoplankton biomasses when considered over the whole experiment but there was a trend towards lower phytoplankton biomass in the enclosure dominated by daphnids during mid-summer. It is concluded that, although planktivorous fish have a strong negative impact on zooplankton community biomass and size structure, the relationship at the next lower trophic level, zooplankton and phytoplankton, is much weaker. Therefore, the biomanipulation of planktivorous fish populations as a management technique to control phytoplankton abundance is largely ineffective. (Author's abstract)
W88-10212

INFLUENCE OF MICROHABITAT ON AVAILABILITY OF DRIFTING INVERTEBRATE PREY TO A NET-SPINNING CADDISFLY,
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 4C.
W88-10213

VARIATION IN THE C:P RATIO OF SUSPENDED AND SETTLING SESTON AND ITS SIGNIFICANCE OF P UPTAKE CALCULATIONS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland). Inst. of Aquatic Sciences.
U. Uehlinger, and J. Bloesch.
Freshwater Biology FWBLAB, Vol. 17, No. 1, p 99-108, February 1987. 3 fig, 4 tab, 26 ref.

Descriptors: *Primary productivity, *Carbon, *Phosphorus, *Seston, *Zooplankton, *Plankton, *Eutrophic lakes, *Limiting nutrients, Sedimentation, Suspended solids, Aquatic populations, Epilimnion, Detritus, Algae, Carbon radioisotopes, Lake Lucerne, Switzerland.

In 1981-84 limnocorral (LC) experiments were performed in Lake Lucerne, Switzerland, to manipulate the planktonic community by varying P fertilization and by removing large zooplankton (with a 95 micron screen). The C:P ratios in both suspended and entrapped seston exceeded the 'ideal' C:P ratio of 106 proposed in another paper when P was limiting algal growth. P fertilization could decrease the sestonic C:P ratio to 106 only when P did not limit algal growth; P additions far exceeding the P loading of eutrophic lakes were necessary to obtain this situation. Changes in epilimnetic C:P ratios were usually related to short-term changes in primary production, caused by variable in situ light conditions and turbulence, and subsequent variation in POC concentrations. Entrapped seston in the 95 micron-filtered LCs showed C:P ratios slightly higher than those of suspended seston, indicating fast P release and slower C mineralization in the epilimnetic nutrient cycle. Removing large crustacean zooplankton enhanced epilimnetic P mineralization, and C:P ratios of entrapped seston in the 95 micron-filtered LCs were increased. Detritus formed a relatively high proportion of the seston and amounted to more than two thirds of the measured POC concentration. Calculations of algal P uptake using information on sestonic C:P ratios and C-14 uptake rates are questionable, as long as detritus cannot be separated from algae and net carbon uptake cannot be accurately measured. (Author's abstract)
W88-10214

ZOOPLANKTON GRAZING ON (METHYL-(3)H)THYMIDINE-LABELLED NATURAL PARTICLE ASSEMBLAGES: DETERMINATION OF FILTERING RATES AND FOOD SELECTIVITY,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
L. Bern.
Freshwater Biology FWBLAB, Vol. 17, No. 1, p 151-159, February 1987. 1 fig, 5 tab, 48 ref. Swedish Natural Science Research Council Grant B-BU 3083-105.

Descriptors: *Tracers, *Zooplankton, *Food habits, *Predation, *Amino acids, *Particulate matter, *Bacteria, *Selectivity, Methyl thymidine, Daphnia, Crustaceans, Lake Norrviken, Sweden, Radioisotopes, Tritium, Cyanophyta, Isotope studies, Limnology.

The grazing of (methyl-(3)H)thymidine-labeled bacteria by zooplankton was studied in Lake Norrviken, Sweden. Animals did not ingest bacteria attached to large colonies of the cyanobacterium Microcystis wesenbergii Kom. but small aggregates of bacteria and free bacteria were readily consumed. Diaphanosoma brachyurum (Lievin), Daphnia cucullata Sars, and Daphnia galeata Sars grazed free bacteria more quickly than aggregates, but Eudiaptomus gracilis (Sars), Chydorus sphaericus Mull, and Bosmina coregoni s.l. Baird grazed the aggregates more readily. Filtering rate determination varied from 1.6 to 125 microliters/individual/hour for various species. The zooplankton species studies were estimated to ingest roughly 0.0001 to 0.001 micrograms bacterial C/individual/hour (if only free bacteria are taken into account). These data indicate that free bacteria alone are hardly an important food resource for crustacean zooplankton populations in Lake Norrviken. (Author's abstract)
W88-10215

CHARACTERIZATION AND DESCRIPTION OF THE MAARSSEVEEN LAKE SYSTEM,
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
W. R. Swain, R. Lingeman, and F. Heinis.
Hydrobiological Bulletin HYBUD9, Vol. 21, No. 1, p 5-16, July 1987. 5 fig, 5 tab, 17 ref.

Descriptors: *Lakes, *Limnology, *Eutrophication, *Mesotrophy, *Netherlands, *Oligotrophy, Trace metals, Atmospheric transport, Morphometry, Anoxia.

The Maarsseveen Lakes system, located near the City of Utrecht, The Netherlands, consists of two major bodies of water, a larger lake (Maarsseveen I) and a smaller lake (Maarsseveen II), interconnected by a maze of channels known as a 'petgaten' area. The hydrodynamics of the lake region coupled with this 'petgaten' areas are responsible for the maintenance of the relatively oligomesotrophic character of Lake Maarsseveen I, as compared with the more eutrophic Lake Maarsseveen II. Both lakes are plagued by problems of summer anoxia, although this phenomenon is far more pronounced in the more eutrophic small lake. Atmospheric deposition is responsible for contributions of significant quantities of trace metals to both lakes, and the River Vecht acts as an additional source for Lake Maarsseveen II. (See W88-10253 thru W88-10258) (Author's abstract)
W88-10252

WATER QUALITY OF THE TWO MAARSSEVEEN LAKES IN RELATION TO THEIR HYDRODYNAMICS,
Water Board of Utrecht (Netherlands).
E. Van Donk.
Hydrobiological Bulletin HYBUD9, Vol. 21, No. 1, p 17-24, July 1987. 5 fig, 3 tab, 7 ref.

Descriptors: *Water pollution sources, *Limnology, *Trace metals, *Water quality, *Hydrodynamics, *Lakes, Groundwater, Oligotrophic lakes, Cadmium, Zinc, Lake sediments, Deposition, Rainwater, Eutrophication.

The hydrodynamics of the two Maarsseveen Lakes is the main cause of the difference in water quality between the lakes. The meso-oligotrophic Lake I is mainly supplied by groundwater and rainwater while the eutrophic Lake II is fed by water from the River Vecht. Both lakes, however, have a relative high concentration of Zn and Cd in their water system and sediment. The mean concentrations of Zn and Cd in the water system are even higher than in the River Vecht. Measurements of atmospheric deposition (dry and wet) illustrated high levels of Zn, Cd and Cu transported to this area. There are indications that three metallurgical industries located in this region are responsible for the high deposition of these metals in the lakes. (See also W88-10252 and W88-10254 thru W88-10258) (Author's abstract)
W88-10253

TIME SERIES OF PHYSICAL, CHEMICAL AND PLANKTON PARAMETERS IN LAKE MAARSSEVEEN I: 1980-1986,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
R. Lingeman, F. Heinis, and A. Veen.
Hydrobiological Bulletin HYBUD9, Vol. 21, No. 1, p 25-38, July 1987. 11 fig, 2 tab, 15 ref.

Descriptors: *Limnology, *Temperature, *Oxygen, *Phytoplankton, *Eutrophication, *Lakes, Nutrients, Aquatic populations, Silicon, Cyanoophyta, Microcystis, Physical properties, Chemical properties.

In 1983, an unexpected bloom of the cyanobacteria Microcystis aeruginosa was observed in Lake Maarsseveen I. It wa supposed that this phenomenon might be an indication of accelerated eutrophication of the lake. However, data on physical, chemical and phytoplankton parameters, collected over the last six years, do not support this contention. Phytoplankton total phosphate and physical characteristics did not change. Annual levels of dissolved nutrients such as silicate and nitrate were even observed to show significant decrease over the period of observation. (See also W88-10252 thru W88-10253 and W88-10254 thru W88-10258) (Author's abstract)
W88-10254

UNDERESTIMATION OF PRIMARY PRODUCTION AS INDICATED BY MEASUREMENTS WITH SIZE-FRACTIONATED PHYTOPLANKTON IN LAKE MAARSSEVEEN I (THE NETHERLANDS),
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
B. J. G. Flik, M. Bos, K. Royackers, and J. Ringleberg.
Hydrobiological Bulletin HYBUD9, Vol. 21, No. 1, p 39-47, July 1987. 4 fig, 3 tab, 27 ref.

Descriptors: *Limnology, *Phytoplankton, *Lakes, *Primary productivity, Zooplankton, Aquatic fauna, Aquatic populations, Animal population, Rotifers, Netherlands.

Primary productivity of four size classes of phytoplankton (< 150 microns < 50 microns < 20 microns and < 5 microns) was measured from March through October 1986 in Lake Maarsseveen I with an incubator technique. The mean column production was approximately 400 mg carbon per sq m per day, with a range of values between 150 and 750 mg carbon per sq m per day. The mean contribution of the size fractions < 50 microns, < 20 microns and < 5 microns to the size fraction < 150 microns was 80%, 60% and 35% respectively. During their appearance, the grazing impact of small herbivorous zooplankton, e.g. rotifers, can give an underestimation of the size fraction < 150 micrometers. An indication of this phenomenon is given. (See also W88-10252 thru W88-10254 and W88-10256 thru W88-10258) (Author's abstract)
W88-10255

SUBMERGED MACROPHYTES IN LAKE MAARSSEVEEN I: CHANGES IN SPECIES COMPOSITION AND BIOMASS OVER A SIX-YEAR PERIOD,
Centre for Agrobiological Research, Wageningen (Netherlands).
E. P. H. Best.
Hydrobiological Bulletin HYBUD9, Vol. 21, No. 1, p 55-60, July 1987. 2 tab, 12 ref.

Descriptors: *Submerged plants, *Lakes, *Species composition, *Limnology, *Macrophytes, *Biomass, *Aquatic populations, Aquatic fauna, Ecosystems, Aquatic flaura, Fish populations, Eutrophication, Water use, Temporal distribution.

The submerge macrophytes of Lake Maarsseveen I (The Netherlands) were surveyed in 1983 using SCUBA diving techniques. Only 40% of the characeans and 75% of the angiosperms detected in 1977 remained. The area colonized by submerged macrophytes was 0.45% upon reexamination in 1983, compared with 25.10% in 1977. The observed decreases were largely attributable to a shift of the plant-colonized areas to shallower depths. By 1983, most of the earlier predominant vegetation types had disappeared and the biomass had decreased. The decline in submerged vegetation may be attributed to increasing eutrophication, fish populations and recreational activities. (See W88-10252 thru W88-10255 and W88-10257 thru W88-10258) (Author's abstract)
W88-10256

PRODUCTION AND DECOMPOSITION OF THE EMERGENT LITTORAL ZONE OF LAKE MAARSSEVEEN I, AN OVERVIEW,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
J. T. Meulemans, and P. J. Roos.
Hydrobiological Bulletin HYBUD9, Vol. 21, No. 1, p 61-69, July 1987. 5 fig, 3 tab, 32 ref.

Descriptors: *Productivity, *Littoral zone, *Lakes, *Aquatic plants, *Limnology, *Decomposition, *Nutrients, Phragmites, Light penetration, Organic matter, Plant growth.

The emergent zone of Lake Maarsseveen I, which occupies 1.3% of the total surface area of the lake, is dominated by Phragmites australis. Growth characteristics of above-ground structures of this reed are presented, as well as nutrient and carbon contents. The former are also presented for the rhizomes. Data are presented on decomposition of leaves and stems of the reed. A description is given of the development of periphytic architecture on dead reed stems, and its relation to submerse and light distribution within periphyton. (See W88-10252 thru W88-10256 and W88-10258) (Author's abstract)
W88-10257

DENSITY FLUCTUATIONS IN POPULATIONS (1982-1986) AND BIOLOGICAL OBSERVATIONS OF POTAMOPYRGUS JENKINSI IN TWO TROPHICALLY DIFFERING LAKES,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
J. Dorgelo.
Hydrobiological Bulletin HYBUD9, Vol. 21, No. 1, p 95-110, July 1987. 4 fig, 5 tab, 68 ref.

Descriptors: *Population density, *Lakes, *Mesotrophy, *Oligotrophy, *Limnology, *Gastropods, *Snails, *Eutrophication, Animal populations, Tolerance, Macrophytes, Aquatic fauna, Life history studies.

The hydrobiid snail Potamopyrgus jenkinsi (E.A. Smith), characterized by parthenogenesis and ovovivipary, was quantitatively sampled monthly between June, 1982, and December, 1986, on sandy bottoms in the shallow zones of the meso-oligotrophic Lake Maarsseveen I and the eutrophic Lake Maarsseveen II (The Netherlands). The snail demonstrated a very clumped distribution in both lakes. The mean numbers of juveniles and adults taken together fluctuated strongly. Organisms in Lake I showed relatively high densities (up to 25,000/sq m) in 1982, followed by a sudden drop to values approaching zero in December, 1982, with a subsequent rapid increase in densities, fluctuating between 2,000 and 200/sq m. In Lake II, densities of snails fluctuated between 13,000 and 300/sq m with decreases in the spring of 1985 and 1986. The various types of decreases in the lakes are extensively discussed, but no explanation is presently available. The reduction in Lake I was of catastrophic proportions, but the speed of recovery of the population was remarkable. Floating was observed only in Lake I, and only during the occurrence of the highest densities on the sediment. Burrowing behavior was very common, but strongly suppressed under an uninterrupted dark regimen. A shift of temperature from 15 to 22C had the same effect. A number of submerged macrophyte species from Lake I proved to attract P. jenkinsi in the absence of sandy substrate, though these plants were only covered by the snail during the period of the highest densities in 1982. Temperatures of 20C or lower were well- tolerated, unlike temperatures of 25 and 30C. Growth was distinct at 10, 15 and 20C. Keeled individuals were encountered in much higher numbers in Lake I than in Lake II. (See W88-10252 thru W88-10257) (Author's abstract)
W88-10258

NEUTRALIZING STRATEGIES FOR ACID WATERS: SODIUM AND CALCIUM PRODUCTS GENERATE DIFFERENT ACID NEUTRALIZING CAPACITIES,
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 5G.
W88-10266

MECHANISMS OF PRECIPITATION OF MANGANESE(II) IN LAKE BIWA, A FRESH WATER LAKE,
Shiga Univ., Otsu (Japan). Dept. of Chemistry.
M. Kawashima, T. Takamatsu, and M. Koyama.
Water Research WATRAG, Vol. 22, No. 5, p 613-618, May 1988. 9 fig, 1 tab, 28 ref.

Descriptors: *Chemical precipitation, *Chemistry of precipitation, *Manganese, *Lakes, *Suspended solids, *Microbial degradation, Adsorption, Oxidation, Equilibrium, River mouth, Bottom water, Ion transport, Lake Biwa Japan, Bacterial physiology.

The precipitation mechanisms of Mn(II) were studied from the viewpoint of adsorption onto suspended solids (SS) and microbial oxidation of Mn in Lake Biwa. In aerobic water samples maintained in the laboratory, the concentration of dissolved Mn(Mn(II)) decreased at pH > 7 by microbially mediated oxidation. Filtration, autoclaving and u.v. light irradiation the water samples and the addition of NaN3 inhibited the precipitation of Mn(II). The adsorption of Mn(II) onto SS was also appreciable at pH > 7, and attained equilibrium within at least 30 min. The oxidation rate of Mn(II) was much less than the adsorption rate. In various environments of the lake (bottom water, sediment surface, river mouth, etc.) the initial adsorption of Mn(II) and subsequent slow oxidation mediated by bacteria may be essential to the mechanisms of Mn(II) precipitation. (Author's abstract)
W88-10270

PROGRESSIVE MODIFICATIONS IN THE STRUCTURE OF BENTHIC INVERTEBRATE COMMUNITIES AS A FUNCTION OF WATER QUALITY OF THE OURTHE AND LESSE (BELGIAN MEUSE) (MODIFICATION PROGRESSIVE DE LA STRUCTURE DES PEUPLEMENTS D'INVERTEBRES BENTHIQUES EN FONCTION DE LA QUALITE DE L'EAU DE L'OURTHE ET LA LESSE (MEUSE BELGE)),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. de Biologie Quantitative.
For primary bibliographic entry see Field 5A.
W88-10280

EFFECTS OF A SEWAGE TREATMENT PLANT ON THE PHYSICO-CHEMICAL QUALITY AND COMMUNITY STRUCTURE OF THE BENTHIC FAUNA OF A POLLUTED RIVER, THE HAUTE-SEMOIS (ETUDE DES EFFETS D'UNE STATION D'EPURATION SUR LA QUALITE PHYSICO-CHIMIQUE ET LA STRUCTURE DE PEUPLEMENT DE LA FAUNE BENTHIQUE D'UNE RIVIERE POLLUEE, LA HAUTE-SEMOIS),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. de Biologie Quantitative.
For primary bibliographic entry see Field 5C.
W88-10281

FISH COMMUNITIES OF THE UPPER DANUBE RIVER (GERMANY, AUSTRIA) PRIOR TO THE NEW RHEIN-MAIN-DONAU CONNECTION,
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W88-10284

HEAVY METAL LOAD OF LAKE IIDESJARVI AS REFLECTED IN ITS SEDIMENTS,
Helsinki Univ. (Finland). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-10287

PCB IN THE SEDIMENTS OF THE LAKE JYVASJARVI,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-10288

OBSERVATIONS OF THE CONNECTION BETWEEN WATER MOVEMENTS AND DEEP-

BOTTOM SEDIMENTS IN LAKE VANAJANSELKA,
Helsinki Univ. (Finland). Dept. of Geophysics.
T. Hiltunen, and P. Kansanen.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 25-35, 1987. 6 fig, 4 tab, 22 ref.

Descriptors: *Finland, *Lake Vanajanselka, *Limnology, *Lake sediments, *Sedimentation, *Water transport, *Water currents, Particle size, Lakes, Sonar, Oscillatory waves, Seasonal variation, Wind stress.

The bottom dynamic conditions were identified in Lake Vanajanselka (where the bottom topography is complicated) on the basis of current measurements, the echosounding profiles and analyses of the particle sizes of the surficial sediments. There was a rift in the bedrock which was not filled effect during the history of the lake. The occurrence of lake ochre was characterized the transportation bottoms in the depression and on the steep slopes of it. Water movements were researched by measuring temperature and current speed in a narrow deep (20.8 m) during summer stratification in 1983. Current measurements in June and July showed oscillating currents with irregular periods of 5-90 h. The average speed at a depth of 0.4 m above the bottom was 6 cm/s. The maximum velocity was 18.2 cm/s to the north in June and 18.3 cm/s to the north in July. In both cases, the wind had blown for several hours from the NW at about 4-8 m/s. The unusual current activity at the deep narrow was noticed to be induced by changing wind stress, which inclines thermocline and affects movements of the mass of hypolimnion. The contraction of the depression increases the current speed. Observed speeds are high enough to hinder sedimentation of fine particles and probably occasionally affect transportation of loose material on the bottom. (Author's abstract)
W88-10289

PHYTOPLANKTON IN LAKE KONNEVESI WITH SPECIAL REFERENCE TO EUTROPHICATION OF THE LAKE BY FISH FARMING,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10290

ELUTION PATTERNS OF AQUATIC HUMUS IN SIZE EXCLUSION CHROMATOGRAPHY BASED ON DIFFERENT ELUANTS,
Joensuu Univ. (Finland). Mekrijaervi Research Station.
For primary bibliographic entry see Field 7B.
W88-10291

EUTROPHICATION OF LAKE LESTIJARVI AS A CONSEQUENCE OF FOREST BOG DITCHING,
Jyvaeskylae Univ. (Finland). Inst. for Environment Research.
For primary bibliographic entry see Field 4C.
W88-10292

COMPARATIVE STUDIES ON MACROPHYTES AND PHYTOPLANKTON IN TEN SMALL, BROWN-WATER LAKES OF DIFFERENT TROPHIC STATUS,
Maj and Tor Nessling Foundation, Helsinki (Finland).
V. Ilmavirta, and H. Toivonen.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 125-142, 1987. 6 fig, 3 tab, 20 ref.

Descriptors: *Macrophytes, *Phytoplankton, *Brown water lakes, *Lakes, *Limnology, *Trophic level, *Eutrophication, *Decomposing organic matter, Water chemistry, Plant growth forms, Finland, Algae, Nutrients, Lake chain.

The lakes in this study, which are situated near Tampere, Finland, form a chain with two legs of four lakes which join a brook before the 9th lake. Nutrient concentrations increased gradually from the lakes at highest elevation to the lowest one and this increase was closely related to the proportion of arable land in the catchment area. The number of related macrophyte species, as well as their amount (expressed as vegetation index), increased along the chain with increasing eutrophy. The proportion of species indicating eutrophy also increased steadily along the course of the chain, both as number of species and biomass. The proportion of plants representing various growth forms also revealed marked differences between lakes with lemnids being restricted to the most nutrient-rich water bodies. Phytoplankton showed a similar trend while the legs of the chain were separate. But after the waters mixed in the 9th lake, the biomass and species number dropped sharply and one genus (Cryptomonas) dominated. This drop was explained by strong ecological stress in mixed communities and the extensive competitive ability of the flagellates in humic waters. (Author's abstract)
W88-10298

DILUTION EFFECTS ON THE FLUORESCENCE MEASUREMENTS OF HUMIC LAKE WATERS,
Helsinki Univ. (Finland). Dept. of Limnology.
For primary bibliographic entry see Field 7B.
W88-10299

EFFECTS OF FILTRATION ON THE DETERMINATION OF PHOSPHATE PHOSPHORUS IN RUNOFF WATERS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5A.
W88-10300

ADEQUACY OF LARGE-SCALE MODELS IDENTIFIED WITH INCOMPLETE FIELD DATA - A CASE STUDY WITH TWO LAKE MODELS,
Helsinki Univ. of Technology, Espoo (Finland). Lab. of Hydrology and Water Resources Engineering.
O. Varis, J. Kettunen, and A. V. Leonov.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 157-165, 1987. 8 fig, 3 tab, 18 ref.

Descriptors: *Model studies, *Mathematical models, Phosphorus, *Statistical models, *Limnology, *Statistical analysis, Model testing, Data acquisition, Algal dynamics, Finland, Hungary, Hydrologic models, Lake Kuortaneenjarvi, Lake Balaton, Eurtrophication, Nitrogen, Incomplete data.

This study was motivated by the question: 'Within a large scale model describing a complex natural system, how adequate and valid can the items identified with incomplete field data be assumed to be in comparison with subsystems better observed.' This question was studied by applying and comparing two water quality models against the same set of field data from Lake Kuortaneenjarvi, Finland. One of the models has previously been constructed to describe algal dynamics based on nitrogen and phosphorus cycles of the lake. The other has been developed for the analysis of the phosphorus dynamics and transformations of Lake Balaton, Hungary. Nine model variables were chosen to represent the models and different categories of observation types: directly and indirectly observed as well as non-observed variables. Statistical comparisons were made between computed and observed values as well as between the simulated values obtained with the tow models. The results show distinctly the problem of uncertainty and inadequacy related to modeling of non-observed subsystems. (Author's abstract)
W88-10301

WATER CURRENTS AND EROSION OF CELLULOSE FIBERS IN A SHORT TERM REGULATED WATER COURSE,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 2J.
W88-10302

WINTER AND SUMMER LOW FLOWS IN FINLAND,
National Board of Waters, Helsinki (Finland). Hydrological Office.
For primary bibliographic entry see Field 2E.
W88-10303

SURVEY OF ACIDIFICATION BY AIRBORNE POLLUTANTS IN 52 LAKES IN SOUTHERN FINLAND,
Finnish Forest Research Inst., Helsinki. Dept. of Peatland Forestry.
For primary bibliographic entry see Field 5B.
W88-10305

STRONG AND WEAK ACIDS IN LAKE WATERS - A METHODOLOGICAL STUDY,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5A.
W88-10307

RESTORATION OF SHALLOW LAKE ECOSYSTEMS, WITH EMPHASIS ON LOOSDRECHT LAKES,
Ministerie van Volkshuisvesting en Ruimtelijke Ordening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 5G.
W88-10341

LOOSDRECHT LAKES, ORIGIN, EUTROPHICATION, RESTORATION AND RESEARCH PROGRAMME,
Limnologisch Inst., Nieuwersluis (Netherlands).
L. Van Liere.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 9-15, November, 1986. 4 fig, 2 tab, 9 ref.

Descriptors: *Lake restoration, *Water pollution effects, *Limnology, *Lakes, *Loosdrecht Lakes, *Eutrophication, *Netherlands, Morphology, Lake morphology, History Conferences, Symposium, Shallow water, Environment, Aquatic environment, Water pollution, Peat, Plankton, Trophic level, Aquatic life, Aquatic animals, Aquatic plants.

The Loosdrecht Lakes of The Netherlands are described to provide background for a seminar on their eutrophication and restoration. These shallow lakes, situated about 20 km southeast of Amsterdam, were created by the excavation of peat. Their waters used to be very clear, with phytoplankton consisting of diatoms and green algae that are typical of mesotrophic water. Currently, Oscillatoria and Lyngbya have outcompeted almost all other algal species, representing up to 95% of the cell numbers averaged over the year. The zooplankton community structure and its grazing rate are also indicative of eutrophic conditions, as is the fish population, dominated by the bream. The organization scheme of the Water Quality Research Loosdrecht Lakes (WQL) project is presented. The aim of this interdisciplinary project is to qualify and quantify the effects of phosphorus load reduction on the functional and structural aspects of a shallow lake ecosystem, to translate these effects in terms of water quality, and to contribute to water management measures for attaining and maintaining the desired water quality. (See also W88-10341, W88-10343 thru W88-10354 and W88-10359) (Doria-PTT)
W88-10342

INTERACTION OF HYDROLOGICAL SYSTEMS AND EUTROPHICATION OF THE LOOSDRECHT LAKES,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
G. B. Engelen.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 17-25, November, 1986. 10 fig, 11 ref.

Descriptors: *Limnology, *Lakes, *Loosdrecht Lakes, *Netherlands, *Surface-groundwater relations, *Eutrophication, Hydrologic systems, Groundwater movement, Trophic level, Biomass, History, Water level, Evapotranspiration, Catchment areas, Phosphorus, Nutrients, Storage, Solute transport, Path of pollutants.

The history of eutrophication of the Loosdrecht Lakes (The Netherlands) and the differences in trophic state of the compartments of this system are described from a hydrological point of view. Groundwater movement was found to be of paramount importance. This groundwater transport induces a horizontal surface water transport with concomitant biomass from the Loosdrecht Lakes to Lake Breukeleveen, which partly explains the more eutrophic situation in the latter lake. Each winter, the Vuntus and Breukeleveen units are flushed with excess precipitation water, draining from the eastern hills. In the summer, their intensified eutrophication cycle starts anew. Detailed studies aimed at quantifying the water and sediment balances for the various storages and the transport and conversion processes of nutrients are underway. (See also W88-10341 thru W88-10342, W88-10344 thru W88-10354 and W88-10359) (Doria-PTT)
W88-10343

MONTHLY MASS BALANCES FOR COMPARTMENTS OF THE LOOSDRECHT LAKES SYSTEM: APPROACH AND PRELIMINARY RESULTS,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
B. F. M. Kal.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 27-39, November, 1986. 7 fig, 2 tab, 13 ref.

Descriptors: *Limnology, *Water quality, *Lakes, *Loosdrecht Lakes, *Netherlands, *Mass transfer, *Eutrophication, Hydrologic models, Model studies, Distribution, Monthly distribution, Water quality, Trophic level, Catchment areas, Nutrients, Solute transport, Chlorophyll, Hydrologic models, Nitrogen, Phosphorus, Storage, Path of pollutants, Evaporation, Infiltration.

Water quality modelling of the Loosdrecht Lakes (The Netherlands) requires mass balances covering periods of one month or less for at least three of the lake compartments of the Loosdrecht Lakes system: (1) the Loosdrecht Lakes, (2) Lake Vuntus, and (3) Lake Brevkelveen. The hydrological system of the Loosdrecht area underlying these mass balances is described. Data available on the various mass balance items are surveyed, as well as the methods considered to calculate those items that do not lend themselves to direct measurement. Masses of Cl, P, and N stored in the three main lake compartments at consecutive sampling dates in 1983 and 1984 are graphically presented and compared with roughly estimated biannual balances of the same substances for the aggregate of the three lake compartments. The distribution of Cl is a function of the differences between the lake compartments in mixing ratios of high-Cl to low-Cl inputs. The amounts of the nutrients P and N stored in the lake water follow a rather erratic course. Thought it is possible to idealize this to a seasonal cycle, the two-year period dealt with by this study is too short to identify such a cycle with certainty. It is suggested that sedimentation, release from sediment, and (presumably) denitrification are of major importance to the amounts of nutrients in the lake water. (Author's abstract)
W88-10344

STUDYING THE PHOSPHORUS RELEASE FROM THE LOOSDRECHT LAKES SEDIMENTS, USING A CONTINUOUS FLOW SYSTEM,
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
P. C. M. Boers.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 51-60, November, 1986. 9 fig, 1 tab, 39 ref.

Descriptors: *Limnology, *Nutrients, *Path of pollutants, *Eutrophication, *Phosphorus, *Lakes, *Loosdrecht Lakes, *Netherlands, *Lake sediments, Continuous flow, Flow, Interstitial water, Temperature, Temperature effects, Acidity, Eutrophication, Trophic level, Seasonal variation, Seepage, Nutrients, Respiration, Aquatic life, Plankton, Oxygen uptake, Chlorophyll a, Solute transport, Sediments, Continuous flow.

Phosphorus release from the Loosdrecht Lakes (The Netherlands) sediments was studied using a continuous flow reactor. The summer release maxima were 4 mg P/sq m/day in 1984 and 1.4 mg P/sq m/day in 1985. Temperature and downward seepage controlled release rates to a great extent, the pH of the overlying water being of only minor importance. From these results, it could be concluded that release processes might be driven by mineralization of particulate organic phosphorus in the sediment. Pore water studies in the sediments of the release reactor confirmed this hypothesis. Phosphorus dissolution rates were calculated from the profiles. (See also W88-10341 thru W88-10345, W88-10354 and W88-10359) (Author's abstract)
W88-10346

PRIMARY PRODUCTION IN THE VARIOUS PARTS OF LOOSDRECHT LAKES,
Limnologisch Inst., Nieuwersluis (Netherlands).
L. Van Liere, L. Van Ballegooijen, W. A. De Kloet, K. Siewertsen, and P. Kouwenhoven.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 77-85, November, 1986. 5 fig, 16 ref.

Descriptors: *Limnology, *Primary productivity, *Lakes, *Loosdrecht *Netherlands, *Eutrophication, Lakes, Productivity, Trophic level,Phosphorus, Solute transport, Photosynthesis, Seston, Biomass, Ecology, Growth, Chlorophyll a, Path of pollutants, Respiration.

The primary production of the Loosdrecht Lakes (The Netherlands), L. Breukeleveen, and L. Vuntus is described. A comparison is made between the values found in 1983 (a year with a considerable influx of phosphorus-rich water) and those of 1984 (when the entering water was dephosphorized). Production rates in L. Breukeleveen and L. Vuntus were significantly lower than in the Loosdrecht Lakes. This was partly ascribed to horizontal mass transport. The annual production in 1984 was not significantly lower than in 1983. (See also W88-10341 thru W88-10346, W88-10348 thru W88-10354 and W88-10359) (Author's abstract)
W88-10347

CARBOHYDRATE DYNAMICS AND GROWTH RATE OF NATURAL PHYTOPLANKTON POPULATIONS,
Amsterdam Univ. (Netherlands). Lab. voor Microbiologie.
T. Burger-Wiersma, and L. R. Mur.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 87-92, November, 1986. 5 fig, 18 ref.

Descriptors: *Cycling nutrients, *Limnology, *Netherlands, *Eutrophication, *Carbohydrates, *Growth rates, *Phytoplankton, *Population dynamics, Dynamics, Metabolism, Aquatic plants, Plankton, Algae, Cyanophyta, Productivity, Primary productivity, Photosynthesis, Distribution, Diurnal distribution, Culturing techniques, Lakes, Loosdrecht Lakes.

The results of field measurements carried out in the growing season of 1984 in the eutrophic Loosdrecht Lakes of The Netherlands are presented. Carbohydrate dynamics of field populations are compared to those found in continuous cultures, and the relationship between photosynthesis and carbohydrate accumulation is discussed. It was found that diurnal changes in carbohydrate content of natural phytoplankton populations differed from those found for blue-green algae grown in continuous cultures. The carbohydrate accumulation rate was not constant during the light period. Also in contrast to results obtained using continuous cultures, the photosynthetic characteristics changed during the light period. A close correlation was observed between changes in carbohydrate accumulation rate and the efficiency of photosynthesis over 24 hours. Seasonal changes in carbohydrate consumption rate over the dark period were proportional to changes in growth. (Author's abstract)
W88-10348

COMPARISON OF PRIMARY PRODUCTION MEASUREMENTS USING TWO LABORATORY SYSTEMS WITH DIFFERENCES IN LIGHT QUALITY,
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
M. Rijkeboer, W. A. De Kloet, and H. J. Gons.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 93-99, November, 1986. 3 fig, 2 tab, 10 ref. European Economic Community Contract ENV-839-NL(N).

Descriptors: *Lakes, *Limnology, *Eutrophication, *Primary productivity, *Light quality, *Loosdrecht Lakes, *Aquatic environment, Productivity, Comparison studies, Absorption, Seston, Biomass, Plankton, Phytoplankton, Aquatic plants, Photosynthesis, Lakes, The Netherlands, Turbidity, Physical properties, Respiration, Environment.

One of the research objectives in the Water Quality Research Loosdrecht Lakes monitoring program is to measure primary production of the seston in the Loosdrecht Lakes. Primary production measurements were carried out simultaneously using two laboratory systems with different light conditions: (1) a 'classical' incubator and (2) a laboratory scale enclosure (LSE). Steele's model, used for calculating primary production, does not correct for spectral changes caused by high phytoplankton biomass. In the incubator, light of almost all wavelengths decreased more or less according to the attenuation of total PhAR in water. In the LSE, high absorption was found of the blue light and some of the red light, which was due to the high sestonic concentration. The Steele function provided a good fit for both sets of data. The depth integrated gross production values derived from the simultaneous measurements were not significantly different. (See also W88-10341 thru W88-10348, W88-10350 thru W88-10354 and W88-10349) (Author's abstract)
W88-10349

PHOSPHATE UPTAKE CAPACITY OF SUMMER PHYTOPLANKTON OF THE LOOSDRECHT LAKES IN RELATION TO PHOSPHORUS LOADING AND IRRADIANCE,
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
J.-P. R. A. Sweerts, H. J. Gons, and W. Rijkeboer.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 101-107, November, 1986. 2 fig, 3 tab, 22 ref. European Economic Community Contract ENV-839-NL(N).

Descriptors: *Solar radiation, *Limnology, *Phosphates, *Lakes, *Loosdrecht Lakes, *Netherlands, *Phosphorus, *Eutrophication, *Phytoplankton, Trophic level, Plankton, Aquatic plants, Growth rate, Nutrients, Absorption.

Summer populations of the phytoplankton of the Loosdrecht Lakes (The Netherlands) were enclosed in laboratory scale enclosures (LSE), supplied with 7.5 micrograms P/l/day and 105 micrograms P/l/day, respectively. The maximum initial phosphate uptake rate (V sub m) was related to irradiance and primary production. At phosphate uptake saturating light-irradiance V sub m values up to 4 times the V sub m values in the dark were measured. The phosphate uptake capacity per unit dry weight remained more or less constant throughout the experiments in the LSE receiving the lower amount of phosphorus, and declined in the LSE receiving the higher amount of phosphorus. Within the range of V sub m values measured, the growth rate of the phytoplankton was not influenced by alterations in phosphorus availability. (See also W88-10341 thru W88-10349, W88-10351 thru W88-10354 and W88-10359) (Author's abstract)
W88-10350

EFFECTS OF WIND ON A SHALLOW LAKE ECOSYSTEM: RESUSPENSION OF PARTICLES IN THE LOOSDRECHT LAKES,
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
H. J. Gons, R. Veeningen, and R. Van Keulen.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 109-120, November, 1986. 8 fig, 1 tab, 21 ref.

Descriptors: *Sediment-water interfaces, *Limnology, *Eutrophication, *Waves, *Lakes, *Loosdrecht Lakes, *Netherlands, *Suspension, *Particulate matter, Environment, Seston, Sediments, Eutrophic lakes, Carbon, Organic carbon, Interfaces, Shallow water, Aquatic environment, Wind.

Horizontal variation of seston concentration in the shallow, eutrophic Loosdrecht Lakes (The Netherlands) was studied in relation to windspeed and effective fetch. Simple wave theory was applied in order to predict resuspension using wind data from a nearby meteorological station. Most results were consistent with the theory, but a clear limit for the occurrence of resuspension could not be established. Generally, changes in epipelon (the particles at the sediment-water interface) were not directly related to computed frequency of resuspension at the sampling station. The frequency was estimated for 37 grid points over the entire lake. Resuspension was computed to affect high percentages of the lake area in winter. In summer, the frequency was much lower, but in June and July, 1984, there were days with nearly 50% of the lake area subject to resuspension. The resulting input of particulate organic carbon into the water column during these days was estimated to equal 12-25 times the daytime phytoplankton carbon fixation. Most of the resuspended matter appeared to be redeposited rapidly. The computed frequency of resuspension for the 37 locations of the lake varied between 7 and 48 days in 1984. (See also W88-10341 thru W88-10350, W88-10352 thru W88-10354 and W88-10359) (Author's abstract)
W88-10351

DIFFERENTIAL FEEDING BEHAVIOUR OF THE DOMINANT CLADOCERA AS AN EXPLANATION OF ZOOPLANKTON COMMUNITY STRUCTURE IN THE LOOSDRECHT LAKES,
University of East Anglia, Norwich (England). School of Environmental Sciences.
K. Irvine.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 121-134, November, 1986. 9 fig, 2 tab, 30 ref.

Descriptors: *Aquatic animals, *Feeding rates, *Food habits, *Limnology, *Eutrophication, *Crustaceans, *Zooplankton, *Ecology, *Lakes, *Loosdrecht Lakes, The Netherlands, Plankton, Eutrophic lakes, Daphnia, Particle size, Algae, Cyanophyta, Phytoplankton, Aquatic plants, Behavior, Animal behavior, Behavior, Diets, Waterfleas, Species composition.

The zooplankton of the shallow eutrophic Loosdrecht Lakes (The Netherlands) is dominated by Bosmina longirostris in the spring period but is replaced by the larger B. coregoni in early summer at a time when phytoplankton populations, dominated by filamentous cyanophytes, are rapidly increasing. Throughout the summer, B. coregoni coexists with the longer, but more slender, Daphnia cucullata. Different size-categories of C14 labelled lake-phytoplankton were fed to natural assemblages of crustacean zooplankton to investigate effects of body length on feeding and the relative selectivities of the Daphnia and Bosmina species on food particle-size. B. coregoni feeds more effectively, especially on larger sizes of food, than B. longirostris, and this may be a factor in the observed change of bosminid species dominance. B. coregoni is able to feed on a wide size range of particles and grazes and assimilates greater volumes of food than D. cucullata. B. coregoni preferentially feeds on food particles greater than 7 microns, whereas D. cucullata selects food below 7 microns. The coexistence of these species appears to depend on a niche separation through different feeding behaviors and selectivities. (See also W88-10342 thru W88-10351, W88-10353 thru W88-10354 and W88-10359) (Author's abstract)
W88-10352

FIRST STEP IN MODELLING PLANKTON GROWTH IN THE LOOSDRECHT LAKES,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
P. Kouwenhoven, and T. Aldenberg.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 135-145, November, 1986. 7 fig, 12 ref.

Descriptors: *Model studies, *Plankton, *Netherlands, *Eutrophication, *Lakes, *Limnology, *Loosdrecht Lakes, The Netherlands, *Algal growth, Trophic level, Dynamics, Carbon cycle, Algae, Irradiation, Phytoplankton, Zooplankton, Aquatic animals, Aquatic plants, Organic matter, Particulate matter, Detritus, Growth, Water quality, Phosphorus.

A dynamic model is presented to simulate plankton growth in the shallow eutrophic Loosdrecht Lakes (The Netherlands). The present version contains only one algal superspecies and incorporates fairly standard formulations for the effects on algal growth of light irradiance, the extinction coefficient of the water, temperature, and the phosphate levels. Grazing by zooplankton and detritus dynamics (non-living particulate organic material) are considered essential parts of the carbon cycle. The total phosphorus concentration is used as a time-variable forcing function, which transforms the problem of predicting future water quality levels into the problem of predicting future total phosphorus levels. This requires a separate estimation procedure. However, both types of estimation should be and can be integrated into one single water quality model. The Loosdrecht Lakes seem P-limited in summer. Readjustment of certain constants is necessary to simulate Lake Breukeleveen, which differs from the Loosdrecht Lakes in certain characteristics. It is hypothesized that some form of phosphorus cell-quota dynamics may solve this problem. The extent to which the hydrological interactions between the Loosdrecht Lakes and Lake Breukeleveen may have caused the observed differences and how this matter could be evaluated through simulation are discussed. (See also W88-10341 thru W88-10352, W88-10354, and W88-10359) (Author's abstract)
W88-10353

FISH COMMUNITY OF THE LOOSDRECHT LAKES AND THE PERSPECTIVE FOR BIOMANIPULATION,
Limnologisch Inst., Oosterzee (Netherlands).
W. L. T. Van Densen, C. Dijkers, and R. Veerman.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 147-163, November, 1986. 6 fig, 9 tab, 32 ref.

Descriptors: *Fish, *Lakes, *Loosdrecht Lakes, *Species composition, *Ecosystems, *Limnology, *Eutrophication, *Netherlands, *Ecology, Fish management, Shallow water, Eutrophic lakes, Growth rate, Fish food, Fish food organisms, Growth, Aquatic life, Aquatic animals, Smelt, Midges, Benthic fauna, Benthos, Fauna, Daphnia, Zooplankton, Fish stocking, Fish management, Food chains.

The fish community of the shallow eutrophic Loosdrecht Lakes (The Netherlands) was characterized with regard to the professional fishery and the forage base. The bream, Abramis brama, dominates the fish biomass. The pikeperch, Stizostedion lucioperca, is the main predator. Bream up to 30 cm have a slow growth rate and are in bad condition. The small bream feed on chironomid larvae, benthic cladocerans, and zooplankton. The better condition of bream over 30 cm is explained by the more efficient feeding of larger bream on Chironomus plumosus larvae. Pikeperch show a fast growth rate and a good condition; recruitment is limited by the low densities of smelt. The impact of the professional gillnet fishery on bream and pikeperch is small because the mesh sizes in use are as large as 75-100 mm bar mesh. The planktivorous pikeperch consumes mainly the carnivorous zooplankters Leptodora kindtii and cyclopoids. The zooplankton community lacks large herbivorous species like Daphnia hyalina, capable of consuming bluegreens. A possible experiment in biomanipulation with a view to find out whether the development of D. hyalina is depressed by the small planktivorous cyprinids, is predator enhancement with the aid of a stocking program for indoor-raised pikeperch in early summer. (See also W88-10341 thru W88-10353 and W88-10359) (Author's abstract)
W88-10354

BIOMANIPULATION AND ITS FEASIBILITY FOR WATER QUALITY MANAGEMENT IN SHALLOW EUTROPHIC WATER BODIES IN THE NETHERLANDS,
Limnologisch Inst., Oosterzee (Netherlands).
A. F. Richter.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 165-172, November, 1986. 2 fig, 29 ref.

Descriptors: *Water quality management, *Eutrophic lakes, *Fish management, *Lake restoration, *Loosdrecht Lakes, *Netherlands, *Food chains, Trophic level, Lakes, Environment, Nutrients, Aquatic plants, Aquatic animals, Aquatic environment, Ecology, Plankton, Phytoplankton, Macrophytes, Benthos, Predation, Fish, Daphnia, Shallow water, Midges.

Literature on biomanipulation as a tool for lake restoration is reviewed. Biomanipulation is based on the exploitation of the interactions both within and between the trophic levels in an aquatic ecosystem. Important among the interactions are: competition for light and nutrients between aquatic macrophytes and phytoplankton and among different phytoplankton species; grazing by planktonic and benthic filter feeders; and size-selective predation by fish. In several case studies, biomanipulation has proved to be successful in restoring mildly eutrophic small water bodies. However, supplementary measures like reducing the external nutrient loadings are needed for long-term stability of the restored ecosystems. The feasibility of the different biomanipulation measures to improve the water quality in shallow Dutch lakes is discussed. Preliminary results on biomanipulation experiments in enclosures with the alga Oscillatoria agardhii and the benthic filter-feeding bivalve Dreissena polymorpha are given. (Author's abstract)
W88-10355

PRELIMINARY RESULTS ON PHOSPHORUS REDUCTION IN LOUGH NEAGH: ASSESSING THE EFFECT AGAINST A BACKGROUND OF CHANGE,
Department of Agriculture for Northern Ireland, Belfast.
C. E. Gibson.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 173-182, November, 1986. 4 fig, 4 tab, 8 ref.

Descriptors: *Phosphorus, *Phosphorus removal, *Lakes, *Eutrophic lakes, *Water pollution treatment, *Lake restoration, *Nutrients, *Cycling nutrients, Shallow water, Sedimentation, Particulate matter, Wastewater treatment, Algae, Cyanophyta, Eutrophication, Trophic level, Phytoplankton, Plankton, Aquatic plants, Ireland.

Lough Neagh is a large (387 sq km), shallow (mean depth 8.9 m) eutrophic lake in Northern Ireland. The phosphorus budget is described in order to illustrate that 75% of the particulate phosphorus input sediments to the bottom and that there is little retention of soluble reactive phosphorus in the lake. Fifty-four percent of the soluble reactive phosphorus loading comes from sewage works, and this is being reduced by phosphorus reduction at the major sewage works. There has been a downturn in the maximum algal crops, particularly of blue-green algae. However, there is an underlying upward trend in soluble reactive phosphorus loading, and the paper stresses the importance of analyzing trends in nutrient budgets to get an accurate evaluation of reduction strategies. (Author's abstract)
W88-10356

CONTROL OF PHOSPHORUS LOADING AND FLUSHING AS RESTORATION METHODS FOR LAKE VELUWE, THE NETHERLANDS,
Ministry of Transport and Public Works, Lelystad (Netherlands).
H. Hosper, and M.-L. Meyer.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 183-194, November, 1986. 8 fig, 2 tab, 3 ref.

Descriptors: *Phosphorus, *Flushing, *Eutrophication, *Lakes, *Cyanophyta, *Lake restoration,

*Water pollution control, Trophic level, Netherlands, Nutrients, Cycling nutrients, Algae, Oscillatoria, Eutrophic lakes, Chlorophyll a, Transparency, Optical properties, Chlorophyta, Diatoms.

As a result of high nutrient loading, Lake Veluwe (The Netherlands) suffered from an almost permanent bloom of the blue-green alga Oscillatoria agardhii. In 1979, the phosphorus loading of the lake was reduced from approx. 3 to 1 g P/sq m.a. Moreover, since then, the lake has been flushed during winter periods with water low in phosphorus. This measure aimed primarily at interrupting the continuous algal bloom. The results of these measures show a sharp decline of total-phosphorus values from 0.40-0.60 mg P/l (before 1980) to 0.10-0.20 mg P/l (after 1980). Summer values for chlorophyll a dropped from 200-400 mg/cu m to 50-150 mg/cu m. The increase in transparency of the lake water was relatively small, from summer values of 15-25 cm before the implementation of the measures to 25-45 cm afterwards. The disappointing transparency values may be explained by the decreasing chlorophyll a and phosphorus content of the algae per unit biovolume. Blue-green algae are gradually losing ground. In the summer of 1985, green algae and diatoms dominated the phytoplankton for the first time since almost 20 years. To achieve the ultimate water quality objectives (transparency values of more than 100 cm in summer), the phosphorus loading has to be reduced further. (Author's abstract)
W88-10357

MATHEMATICAL MODELLING OF PRIMARY PRODUCTION IN GREEN BAY (LAKE MICHIGAN, USA), A PHOSPHORUS- AND LIGHT-LIMITED SYSTEM,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
M. T. Auer, and R. P. Canale.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 195-211, November, 1986. 10 fig, 21 ref.
EPA Grants R809521 and R810076.

Descriptors: *Mathematical models, *Model studies, *Primary productivity, *Limnology, *Lake Michigan, *Phosphorus, *Light penetration, *Eutrophication, *Productivity, Trophic level, Transparency, Optical properties, Algae, Biomass, Depletion, Oxygen depletion, Hypolimnion, Turbidity, Oligotrophy, Lakes, Carbon, Organic carbon.

The concepts of mathematical modelling are demonstrated for the case of lake restoration efforts in Green Bay, Lake Michigan. Striking gradients in water quality (transparency, algal standing crop, hypolimnetic oxygen depletion) and trophic state occur along the major axis of the bay in response to phosphorus loaded from the Fox River. A simple model for gross primary production is developed to permit calculation of the relative importance of internal carbon production to the total organic carbon budget of the bay. Primary production varies from high rates over a limited photic depth in the turbid, phosphorus-rich waters of the eutrophic portions of the bay to low rates over an extensive photic depth in the transparent, phosphorus-poor reaches of the oligotrophic regions. Internal production accounts for approximately 90% of the total organic carbon loaded to the system over the summer growing season. Water quality management strategies must address the stimulation of primary production by phosphorus loaded from the Fox River in any attempt to lower the standing crop of nuisance algae, improve water clarity, and reduce rates of hypolimnetic oxygen depletion in Green Bay. (Author's abstract)
W88-10358

PHOSPHORUS ACCUMULATION IN SEDIMENTS AND INTERNAL LOADING,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
L. Lijklema.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 213-224, November, 1986. 4 fig, 4 tab, 5 ref.

Descriptors: *Phosphorus, *Accumulation, *Sediments, *Nutrients, *Cycling nutrients, *Lakes, *Sediment-water interfaces, *Limnology, *Model studies, Porosity, Distribution, Spatial distribution, Loosdrecht Lakes, Netherlands, Iron, Heavy metals, Temperature, Seasonal variation, Phosphates, Solute transport.

Two simple conceptual approaches are presented for the description of phosphorus accumulation and release from sediments. The first model is a mass-balance over the well-mixed top layer, and demonstrates the enhanced initial effect of sediment dilution on the long-term accumulation, which is magnified in the resulting internal loading, as a consequence of diffusive and advective transport, chemical equilibria, and mineralization. Two assumptions for the spatial distribution of mineralization are evaluated in two sets of analytical solutions for a number of boundary conditions. Results of model calculations are compared with some field data of Loosdrecht Lakes, The Netherlands. The analysis presented here allows a quick evaluation of release rates that can be related to measurable quantities and applied to a range of conditions occurring in the field during the season and at various locations. Estimates of release rates from deep and shallow zones in lakes, for winter, spring, summer, and fall conditions regarding loading and temperature, etc. can be obtained. Also, the models allow an interpretation of laboratory and field data and will stimulate the organized planning of experimental work. (See W88-10341 thru W88-10354) (Author's abstract)
W88-10359

IMPACT OF PHOSPHORUS AVAILABILITY ON MODELLING PHYTOPLANKTON DYNAMICS,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. Depinto, T. C. Young, and D. K. Salisbury.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 225-243, November, 1986. 9 fig, 1 tab, 13 ref.

Descriptors: *Phosphorus, *Model studies, *Mathematical models, *Limnology, *Phytoplankton, *Eutrophication, *Lakes, Eutrophic lakes, Trophic level, Aquatic plants, Plankton, Nutrients, Phosphorus compounds, Particulate matter, Chlorophyll a.

Regulation of phosphorus loading is considered to be the primary method of eutrophication control for many lake systems. It is therefore necessary to have accurate estimates of the forms and bioavailability of all phosphorus sources in order to develop the most cost effective load control measures. Research has revealed a significant difference between the algal availability of allochthonous and autochthonous particulate phosphorus. This paper presents the results of modifying an existing multinutrient phytoplankton model by separating allochthonous phosphorus into three forms: soluble reactive phosphorus (SRP), immediately available for algal uptake; external ultimately-available phosphorus, not immediately available but converted to an available form at a specific rate; and external refractory phosphorus (ERP), not available while in the water column. Comparisons between the original and modified models showed that the modified phosphorus dynamics proved to be a viable alternative to the concept of invoking an unexplained soluble phosphorus water column loss term, employed in the original model. The work also demonstrates that the distinction is significant for lakes receiving a significant portion of their external phosphorus load in a particulate (not immediately available) form and having a morphometry and hydrology such that this particulate phosphorus remains in the water column for longer than about two weeks. (Author's abstract)
W88-10360

MODELLING THE RECOVERY OF HYPERTROPHIC L. GLUMSO (DENMARK),
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
L. Kamp-Nielsen.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 245-255, November, 1986. 7 fig, 4 tab, 11 ref.

Descriptors: *Model studies, *Lakes, *Eutrophic lakes, *Lake restoration, *Limnology, *Nutrients, *Water quality management, *Denmark, Trophic level, Plankton, Eutrophication, Phytoplankton, Zooplankton, Aquatic plants, Aquatic animals, Fish, Cycling nutrients, Biomass, Productivity, Seasonal variation, Simulation, Retention time, Chlorophyll.

Diversion of sewage from Lake Glumso (Denmark) reduced phosphorus loading from 6.0 g P/sq m/yr to 1.6 g P/sq m/yr. Chlorophyll levels during summer were reduced from 600-800 mg Chl/cu m to about 200 mg Chl/cu m mainly by extended periods with phosphorus limitation. Internal phosphorus loading was significant in the first 2 years after nutrient reduction. Predictions of the recovery were made by both simple, empirical models and with complex, dynamic model versions. The actual responses of Lake Glumso were compared with both previously published predictions and predictions made with improved model versions. Objective functions of 0.18 and global correlation coefficients of 0.89 could be achieved. (Author's abstract)
W88-10361

GROUND INFLOW OF NUTRIENTS FROM CATCHMENT AREAS INTO TWO LAKES OF THE LECZYNSKO-WLODAWSKIE LAKE DISTRICT OVER A PERIOD OF THREE YEARS,
Akademia Rolnicza, Lublin (Poland). Inst. of Soil Science and Agricultural Chemistry.
For primary bibliographic entry see Field 5B.
W88-10365

INDICES OF BACTERIOLOGICAL AND CHEMICAL QUALITY OF WATERS IN THE UPPER SILESIAN INDUSTRIAL REGION (SOUTHERN POLAND) AFFECTED BY ATMOSPHERIC POLLUTION AND INDUSTRIAL WASTES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10367

ALGAE AND SOME BACTERIA IN THE PLANKTON OF THE RIVER MALA PANEW AND ITS TRIBUTARIES POLLUTED WITH INDUSTRIAL DISCHARGED WATERS (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10369

STRUCTURE OF A DIATOM COMMUNITY IN THE SPRING SECTOR OF A STREAM WITH LOW PH (BIALA WISELKA, SILESIAN BESKID, POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2E.
W88-10370

SPATIAL DISTRIBUTION, BIOMASS, CHLOROPHYLL-A CONTENT, AND PRIMARY PRODUCTION OF CHAROPHYCEAE IN LAKE ZMARLE (NORTHERN POLAND),
Nicholas Copernicus Univ. of Torun (Poland). Inst. of Biology.
A. S. Oleksowicz.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 165-180, 1986. 3 fig, 1 tab, 42 ref.

Descriptors: *Limnology, *Biomass, *Chlorophyll a, *Primary productivity, *Lakes, *Chlorophyta, *Algae, Distribution, Ecology, Spatial distribution, Physiological ecology, Productivity, Poland, Plant physiology, Zones, Littoral zone, Water depth, Nitrogen compounds, Phosphorus compounds, Nutrients, Cycling nutrients, Photosynthesis.

The spatial distribution of five species of Charophyceae was studied in Lake Zmarle, a mesotrophic dimictic lake in Northern Poland. Also studied were the biomass, chlorophyll-a content, and production of three species with optimum develop-

ment at different depths. Mean biomass, diminishing with depth, was as follows (in g dry weight per sq dm): Chara tomentosa, 3.42 (3 m); C. globularis, 2.56 (6 m); and Nitella flexilis, 1.17 (9 m). Chlorophyll-a content in micrograms/mg dry weight was 1.357, 2.527, and 5.427, respectively. The production of C. globularis and C. tomentosa were the greatest, and that of N. flexilis the lowest. Results confirm the importance of Charophyceae in the lake ecosystem. Their large biomass (50% of the total biomass of the lake's primary producers) is associated with a very great accumulation of nutrients in their thalli. The long vegetation phase of these algae, their ability to carry out photosynthesis even under ice cover, and the long decomposition period of their thalli contribute to their important role in the circulation and inactivation of nitrogen and phosphorus. (Doria-PTT)
W88-10371

FORMS OF MINERAL PHOSPHORUS IN THE BOTTOM SEDIMENTS OF THE LUBACHOW RESERVOIR AND LAKE SLAWA (SOUTHWESTERN POLAND),
Wyzsza Szkola Inzynierska, Zielona Gora (Poland).
A. Solski.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 3/4, p 267-278, 1986. 3 fig, 2 tab, 18 ref.

Descriptors: *Phosphorus compounds, *Bottom sediments, *Reservoirs, *Lakes, *Chemical composition, *Cycling nutrients, Sediments, Poland, Iron, Calcium, Aluminum, Distribution, Horizontal distribution, Flow, Nutrients, Interfaces, Sediment-water interfaces, Dams, Adsorption, Chemical properties, Eutrophication, Lake Slawa, Lubachow Reservoir.

The processes of release and adsorption of phosphorus by the bottom sediments of the Lubachow reservoir and Lake Slawa (Southwestern Poland) were studied on the basis of determination of organic phosphorus and three forms of mineral phosphorus. A regularity in their horizontal distribution according to the direction of the water flow was found. A tendency towards a decreasing content of phosphorus combined with calcium at the bottom of both water bodies, in conformity with the direction of water flow, might be explained by the precipitation of poorly soluble calcium carbonate as an effect of biological processes. The occurrence of relatively great amounts of phosphorus combined with calcium in the central part of Lake Slawa might be due to the vascular plants and greater water dynamics. The gradual decrease in phosphorus combined with increasing distance from the sources of water inflow is the result of yet unknown chemical and biological processes. The sediments of the Lubachow reservoir, which are richer in iron, contained greater amounts of phosphorus combined with iron. The sediments of Lake Slawa, more abundant in calcium, contained greater amounts of phosphorus combined with calcium. (Author's abstract)
W88-10373

HYDROCHEMICAL CHARACTERISTICS OF THE WISLA-CZARNE RESERVOIR (SOUTHERN POLAND) IN THE PERIOD 1975-1984,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 5B.
W88-10375

VERTICAL DISTRIBUTION OF CERTAIN ORGANOCHLORINE COMPOUNDS IN THE MONOMICTIC LAKE ZONAR (CORDOBA, SPAIN),
Cordoba Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 5B.
W88-10376

LABORATORY STUDIES IN THE EFFECT OF DIFFERENT CONDITIONS OF OXYGENATION ON THE BIOSESTON OF THE UPPER VISTULA (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10378

COMMUNITIES OF SESSILE ALGAE IN THE RIVER DUNAJEC, ABOVE AND BELOW THE DAM RESERVOIRS OF ROZNOW AND CZCHOW (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10379

BOTTOM INSECTS, CHIEFLY CHIRONOMIDAE, IN THE RIVER MALA PANEW AND ITS TRIBUTARIES POLLUTED WITH INDUSTRIAL WASTES (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10380

COMPARISON OF COMMUNITY STRUCTURE AMONG STREAMS WITH DIFFERENT TEMPORAL FLOW REGIMES,
Cornell Univ., Ithaca, NY. Dept. of Entomology.
C. M. Delucchi.
Canadian Journal of Zoology CJZOAG, Vol. 66, No. 3, p 579-586, March 1988. 4 fig, 2 tab, 36 ref. Hatch Project No. 139425.

Descriptors: *Streams, *Species composition, *Ecology, *Aquatic habitats, *Riffles, *Benthic fauna, Perennial streams, Stream discharge, Intermittent streams, Nonperennial streams, Classification, Stream classification, Aquatic animals, Benthos, Fauna, New York, Adaptation, Seasonal variation, Migration.

A study was conducted in four streams in the same watershed in New York (Ellis Hllow area, Tonpkins Conty) to determine whether the benthic invertebrate community structure varied among streams with different temporal flow regimes. Timed kick samples were taken from 13 riffles and 4 pools once a month from June to November, 1982. Riffle sites were classified according to temporal flow regime as permanent, intermittent (dry for less than 3 months), or dry (dry for more than 3 months), and varied in size as a function of discharge. Ordination analysis (detrended correspondence analysis) showed that the structure of the benthic invertebrate communities in these streams was related not only to riffle permanence, but also to other abiotic and biotic parameters. Differences in community structure were greater between adjacent pools and riffles than between temporary and permanent riffles. Stream size, seasonal changes in taxa, how recently the riffle had dried, and the length of the dry period contributed to differences in community structure among riffles. Results suggest that differences in community structure between permanent and temporary riffles are minimized by generalized adaptations of stream benthos, such as high rates of migration, drought-resistant eggs, and the tendency to take refuge in the hyporheic zone. (Author's abstract)
W88-10411

BREEDING SUCCESS OF COMMON LOONS (GAVIA IMMER) IN RELATION TO ALKALINITY AND OTHER LAKE CHARACTERISTICS IN ONTARIO,
Trent Univ., Peterborough (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10413

RECHARGE-DISCHARGE FUNCTION OF WETLANDS NEAR JUNEAU, ALASKA: PART I. HYDROGEOLOGICAL INVESTIGATIONS,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W88-10415

EFFECT OF DOMESTIC SEWAGE ON THE STRUCTURE OF THE MICROBENTHIC CILIATE COMMUNITIES IN THE LYNA RIVER,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Water and Wastewater Biology.
For primary bibliographic entry see Field 5C.
W88-10437

SEASONAL CHANGES IN METABOLIC RATES OF ZOOPLANKTON AND THEIR IMPORTANCE TO PHYTOPLANKTON PRODUCTION IN TWO NEW ZEALAND LAKES OF CONTRASTING TROPHIC STATE,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
M. R. James.
New Zealand Journal of Marine and Freshwater Research, Vol. 21, No. 4, p 573-583, 1987. 7 fig, 2 tab, 43 ref.

Descriptors: *Zooplankton, *Lakes, *Limiting nutrients, *Limnology, *Phytoplankton, *Aquatic productivity, *Eutrophic lakes, *Oligotrophic lakes, *Nitrogen cycle, Biomass, Excretion, Respiration, Primary productivity, Seasonal variation, Ecosystems, Copepods, Metabolism, New Zealand.

Zooplankton and water were sampled from Lakes Taupo and Rotongaio from July 1985 to June 1986. Zooplankton excretion and respiration rates were measured for the copepod Boeckella propinqua and excretion rate also for the zooplankton community. Photosynthetic C-14 uptake was measured to estimate phytoplankton nitrogen requirements. Highest metabolic rates were found in spring and summer in both lakes. In eutrophic Lake Rotongaio, metabolic rates were closely correlated with temperature. In Taupo, a large oligotrophic lake, food supply was also an important variable. The atomic O:N ratio (oxygen consumption : nitrogen excretion) indicated protein utilization for B. propinqua from Lake Rotongaio, but an alternation between protein and stored lipids for Lake Taupo specimens. The potential contribution of nitrogen regeneration by zooplankton excretion to phytoplankton nutrient requirements was greatest during early stratification in both lakes when zooplankton biomass was greatest (up to 160% of estimated requirements in Lake Rotongaio and 214% in Lake Taupo). Regenerated nitrogen is a major source of nitrogen for Lake Taupo phytoplankton but in Lake Rotongaio other sources are more important. (Author's abstract)
W88-10439

ZOOPLANKTON ABUNDANCE AND DIVERSITY IN SPRING LAKE, FLORIDA,
Florida State Dept. of Environmental Regulation, Tampa. Southwest District.
B. D. Billets, and J. A. Osborne.
Florida Scientist FLSCA, Vol. 48, No. 3, p 129-139, Summer 1985. 3 tab, 35 ref.

Descriptors: *Zooplankton, *Population density, *Species diversity, *Florida, *Limnology, *Oligotrophic lakes, Crustaceans, Seasonal variation, Lakes, Acidic water, Rotifers, Copepods, Cladocerans.

Seasonal variation in zooplankton abundance and diversity in Spring, Lake Florida was studied between 1973 and 1976. This clear, sand bottom lake is among Florida's lakes that have the highest water quality. The zooplankton community in Spring Lake was characterized by low abundance (monthly means < 100 individuals/L) and high Shannon diversity (monthly means were 3.0-4.0). A rich rotifer fauna was mainly responsible for variation in monthly mean values for the Shannon and Simpson indices. Eighty-three zooplankton species were collected: 60 were rotifers, 16 were cladocerans, and 7 were copepods. Forty-one zooplankton species (27 rotifers, 7 cladocerans, and 7 copepods) were common between years. The pattern of flow abundance and high diversity for the zooplankton in Spring Lake is considered an indication of oligotrophic-like conditions. (Author's abstract)
W88-10442

BENTHIC MACROINVERTEBRATE RESPONSE TO AQUATIC VEGETATION REMOVAL BY GRASS CARP IN NORTH-FLORIDA RESERVOIR,
Florida Dept. of Natural Resources, Tallahassee.
A. J. Leslie, and G. J. Kobylinski.
Florida Scientist FLSCA, Vol. 48, No. 4, p 220-231, Autumn 1985. 2 fig, 4 tab, 38 ref.

Descriptors: *Benthic fauna, *Macroinvertebrates, *Aquatic plants, *Carp, *Grass carp, *Reservoir operation, Temporal variation, Population dynamics, *Reservoirs, *Aquatic weed control, Midges, Oligochaetes, Macrophytes, Watermilfoil, Pondweed, Florida.

Grass carp, Ctenopharyngodon idella, 61/ha, were introduced into a 1900-ha North-Florida reservoir with dense populations of Illinois pondweed, Potamogeton illinoensis, and Eurasian watermilfoil, Myriophyllum spicatum. Aquatic vegetation and benthic macroinvertebrates were monitored for forty-one months. Grass carp feeding activities eliminated Illinois pondweed two years after initial stocking, and the Eurasian watermilfoil was greatly reduced three years after stocking. In spite of the reduction in the aquatic plant habitat, total benthic macroinvertebrates increased significantly. Much of the increase occurred among the Chironomini (Diptera), Oligochaeta, and Tanytarsini (Diptera). The progressive increase in total catch of invertebrates may be related to degree of macrophyte removal by grass carp. Partial control of vegetation was achieved during the second year and early third year, corresponding with an average 73% increase in benthos. Near total control of the vegetation occurred in late third and fourth years, with a corresponding 274% increase in benthic invertebrates over that present in the first year. We hypothesize that depletion of the macrophytes and deposition of partially digested plant material by grass carp could increase available food by release of nutrients for periphytic algal production and subsequent utilization by benthos (planktonic chlorophyll a decreased). The increase in particulate organic matter (indicated by a significant increase in turbidity and Kjeldahl nitrogen) would also favor an increase in benthic detritivores. (Author's abstract)
W88-10445

RELATIONSHIP BETWEEN HYDROLOGY AND VEGETATIONAL PATTERN WITHIN THE FLOODPLAIN MARSH OF A SUBTROPICAL, FLORIDA LAKE,
Saint Johns River Water Management District, Palatka, FL. Dept. of Water Resources.
E. F. Lowe.
Florida Scientist FLSCA, Vol. 49, No. 4, p 213-233, Autumn 1986. 7 fig, 3 tab, 54 ref.

Descriptors: *Hydrology, *Vegetation, *Plant populations, *Topography, *Grasses, *Flood plains, *Marshes, *Distribution patterns, Spatial distribution, Distribution graphs, Zoning, Fires, Hydrologic systems, Subtropic zone, Lakes, Blue Cypress Lake Florida.

The floodplain marsh of Blue Cypress Lake, in east-central Florida, was examined to determine the spatial pattern of the vegetation and its relationship to hydrologic conditions. Visual observation and direct gradient analysis of shoreline vegetation indicated six floristic zones. The sequences of biomass maxima of common species and their distributional limits with respect to elevations suggested that this zonation was a result of a complex-gradient in long-term hydrologic factors caused by topographic relief. Beyond the lake shore, on the marsh flat, the zoned pattern was replaced by a mosaicof communities similar to those of large areas of the Everglades. That portion of the mosaic accounted for by communities dominated by Cladium jamaicense (sawgrass) and Panicum hemitomon (maidencane) apparently did not result from hydrologic factors. This was suggested by the sharp borders typically found between these two communities and by the low topographic relief, and consequent uniformity of hydrologic conditions of the marsh flat. Fire may be the major effector of pattern for these communities by the following mechanism. Maidencane, and its associated species, rapidly colonize areas where dense stands of sawgrass were destroyed by intense fire and then inhibit establishment of sawgrass seedlings. Sawgrass reclaims these areas, through vegetative reproduction, as a slowly moving front which monopolizes space and light. (Author's abstract)
W88-10447

PERIPHYTIC ALGAL GROWTH IN A HYPEREUTROPHIC FLORIDA LAKE FOLLOWING A WINTER DECLINE IN PHYTOPLANKTON,
Northern State Coll., Aberdeen, SD. Dept. of Natural Sciences.
L. M. Hodgson, S. B. Linda, and D. E. Canfield.
Florida Scientist FLSCA, Vol. 49, No. 4, p 234-241, Autumn 1986. 5 fig, 17 ref. Dept. of Agriculture, ARS Cooperative Agreement 58-7B30-0-177.

Descriptors: *Periphytic algae, *Algae, *Eutrophic lakes, Seasonal variation, *Epiphytes, *Periphyton, *Population dynamics, Algal growth, Chlorophyta, Cyanophyta, Phytoplankton, Succession, Diatoms, Species diversity, Biomass, Secchi disks, Florida.

Lake Wauberg, Florida, has a long history of blue-green algal dominance throughout the year, whith annual mean Secchi depths of 0.5 m. Growth of periphytic algal species on submersed glass slides was negligible in winter under the usual bloom conditions. In February 1981, the phytoplankton population drastically decreased in biomass. Secchi depth rose to 3.0 m, and periphytic algal standing crops on glass slides dramatically increased. As the phytoplankton populations recovered, periphytic algal standing crop decreased. A succession of green algae in February, green algae and cryptomonads in March, and blue-green algae by April 1982, was observed as the phytoplankton recovered pre-collapse densities. The periphyton succession was dominated by green algae in March, green algae and diatoms in April-May, and by blue-green algae in June and July. Phytoplankton diversity decreased during the recovery period, and was negatively correlated with total biovolume. Periphyton diversity increased as the phytoplankton recovered and periphyton biovolume decreased to annual mean levels. (Author's abstract)
W88-10448

EFFECT OF DISTANCE FROM A SOURCE POOL ON PROTOZOAN COLONIZATION OF ISOLATED AQUATIC SYSTEMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
P. V. McCormick, P. M. Stewart, and J. Cairns.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 1-15, June 1987. 4 fig, 4 tab, 32 ref.

Descriptors: *Microenvironment, *Colonization, *Ponds, *Protozoa, *Isolation, *Distribution patterns, Ephemeral lakes, Aquatic Ecosystems, Species diversity, Equilibrium.

Triplicate, 30-liter plastic microcosms containing pasteurized pond water and polyurethane foam substrate sampling devices were placed at 10, 32, and 100 m from an isolated, ephemeral pond near the Virginia Polytechnic Institute and State University campus, Blacksburg, Virginia. A single substrate was collected from each container on days 3, 9, 15, 22, 29, and 36 and sampled for the number and kinds of protozoan species present. The process of species accrual in the pond and the containers was adequately explained by the MacArthur-Wilson equilibrium model. Dummy variable analysis revealed no difference in the rate of colonization among the three distances, but the estimated number of species at equilibrium decreased significantly at 100 m from the pond, as did similarity with the pond fauna, also suggesting a distance effect with respect to the pond. Extinction and immigration curves fitted as a function of time suggested that the probability of a species successfully colonizing an island increased as early stages of community development proceeded. Data presented for microbial species accrual in isolated systems appear to be best explained by an interactive model of colonization; the successful colonization of pond species appears to be dependent on the initial arrival of pioneer species, most of which are present in the soil and atmosphere. (Author's abstract)
W88-10449

AGE CLASS DISTRIBUTION AND SIZE OF AMERICAN EEL (ANGUILLA ROSTRATA) IN THE SHETUCKET/THAMES RIVER, CONNECTICUT,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 8I.
W88-10450

LIMNOLOGICAL CHARACTERISTICS OF SANGRE ISLE LAKE, OKLAHOMA (U.S.A.),
Oklahoma State Univ., Stillwater. Dept. of Microbiology.
D. A. Francko.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 53-60, June 1987. 8 fig, 9 ref. National Science Foundation Grants DEB-8012164 and BSR-8214577.

Descriptors: *Limnology, *Lake morphology, *Reservoirs, *Eutrophic lakes, Isotherms, Oklahoma, Water temperature, Bathythermographs, Alkalinity, Phytoplankton, Oxygen, Chlorophyll a.

Although many limnological surveys have been conducted on major reservoirs in the southcentral United States, little is known about the physicochemical and biotic properties of small impoundments, which constitute the majority of aquatic systems in this part of the country. The major limnological characteristics of Sangre Isle Lake, a small impoundment in northcentral Oklahoma, were evaluated during 1982-1983. Seasonal patterns of temperature stratification, Secchi disk profiles, phytoplankton densities, and time versus depth plots of dissolved oxygen concentrations, pH, and alkalinity were examined. Collectively, the data indicate that this lake has limnological features closely resembling those of a typical small, natural eutrophic lake. Further study on systems similar to Sangre Isle Lake should permit the general classification of these small reservoirs into trophic categories usually associated with natural lakes of the northern United States and Europe. (Author's abstract)
W88-10452

RELATION BETWEEN HUMAN PRESENCE AND OCCURRENCE OF GIARDIA CYSTS IN STREAMS IN THE SIERRA NEVADA, CALIFORNIA,
Geological Survey, Sacramento, CA.
For primary bibliographic entry see Field 5B.
W88-10453

IMPACT OF TILAPIA GRAZING ON PLANKTON COMPOSITION IN ARTIFICIAL PONDS IN GUANACASTE, PROVINCE, COSTA RICA,
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
M. Dickman, and H. Nanne.
Journal of Freshwater Ecology JFREDW, Vol 4, No. 1, p 93-100, June 1987. 3 fig, 2 tab, 20 ref.

Descriptors: *Tilapia, *Fish farming, *Fish food organisms, *Plankton, *Species composition, *Fish ponds, Flagellates, Cyanophyta, Microcystis, Population density, Phytoplankton, Zooplankton, Rotifers, Copepods, Dissolved oxygen, Chlorophyta, Costa Rica.

Twenty-seven shallow tilapia culture ponds, having fish densities of 0.1 to 12 individuals/sq m were studied in Guanacaste Province, Costa Rica. Temporal changes in plankton community structure following the emptying and subsequent filling of each pond were noted. In general, newly filled ponds were initially colonized by microflagellates, which in turn were replaced by green and finally blue green algae. Microcystis aeruginosa frequently became the dominant phytoplankter. Its density was correlated with both high tilapia densities and low zooplankton concentrations. When tilapia densities were maintained below 0.5 fish/sq m, the

copepod Mesocyclops leukartii dominated the zooplankton community, and algal biomass was moderate. At higher tilapia densities, rotifers replaced copepods as the dominant zooplankters. When tilapia densities exceeded two adult fish/sq m, negligible zooplankton levels were attained, and phytoplankton densities reached their highest levels (> 2 times 10 to the 6th cells/ml). At these high algal densities, nighttime dissolved oxygen concentrations were so low that the tilapia were forced to the water's surface to breathe. As a result, tilapia predation by fish-eating birds was significant. (Author's abstract)
W88-10455

BENTHOS IN BEAR CREEK, MISSISSIPPI: EFFECTS OF HABITAT VARIATION AND AGRICULTURAL SEDIMENTS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 5C.
W88-10456

DIEL AND SEASONAL CHANGES OF DISSOLVED OXYGEN AND PH IN RELATION TO COMMUNITY METABOLISM OF A SHALLOW RESERVOIR IN SOUTHEAST MISSOURI,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
G. D. Wylie, and J. R. Jones.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 115-125, June 1987. 5 fig, 3 tab, 33 ref.

Descriptors: *Seasonal variation, *Dissolved oxygen, *Hydrogen ion concentration, *Metabolism, *Ecosystems, *Shallow lakes, *Diel variation, *Reservoirs, Macrophytes, Biomass, Photosynthesis, Chemical properties, Missouri.

Diel changes of dissolved oxygen (DO) and pH were measured during 1981-1982 in Pool 1, a shallow reservoir in southeast Missouri. Diel changes in spring and fall were about half those of summer when extensive macrophyte biomass apparently had a strong influence on dynamics of DO and pH. During summer, daily pulses averaged 5.45 mg/L DO and 0.88 pH units, and extreme diel changes were 10-14 mg/L DO and 2-3 pH units. Ambient values of DO and pH were directly related to each other as was the magnitude of their daily changes because in the low alkalinity water of Pool 1, pH as well as DO responded to photosynthesis and respiration. Magnitudes of DO and pH changes at night were strongly related to fluctuations during the day, suggesting that community respiration was in a steady state relationship with photosynthesis over time. (Author's abstract)
W88-10457

EVALUATION OF AN AQUATIC ECOREGION CLASSIFICATION OF STREAMS IN ARKANSAS,
Northrop Services, Inc., Corvallis, OR.
C. M. Rohm, J. W. Giese, and C. C. Bennett.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 127-140, June 1987. 5 fig, 3 tab, 34 ref. EPA Contract 68-03-3124.

Descriptors: *Stream biota, *Environmental impact, *Ecosytems, *Stream classification, *Aquatic ecoregions, Watersheds, Land use, Vegetation, Soil types, Topography, Water quality, Evaluation, Arkansas.

The efficiency of a regional stream classification system, based on the principle that streams reflect the character of the lands they drain, was evaluated in Arkansas. The classification consisted of six aquatic ecoregions defined by relatively homogeneous types of land-surface form, soil, potential natural vegetation and land use. Fish, physical habitat and water quality were sampled in 22 streams throughout the state. Data subjected to ordination analysis generally showed greater similarity in streams within the same ecoregion than in streams in different ecoregions. The patterns developed separately from fish, physical habitat and water quality data sets were relatively concordant. The null hypothesis that the classification did not reflect fundamental differences among the streams was rejected. A regional stream classification is potentially useful for evaluating and managing streams. The identification of regions containing streams with similar character can aid in selecting reference streams for impact assessments or in selecting monitoring sites from which results may be extrapolated regionally. (Author's abstract)
W88-10458

RESISTANCE OF THE PROSOBRANCH MOLLUSK, POTAMOPYRGUS JENKINSI (E.A. SMITH 1889) TO INCREASING TEMPERATURES: AN EXPERIMENTAL STUDY (RESISTANCE DU MOLLUSQUE PROSOBRANCHE POTAMOPYRGUS JENKINSI (E.A. SMITH, 1889) AUX TEMPERATURES CROISSANTES: ETUDE EXPERIMENTALE),
Limoges Univ. (France).
C. Vareille-Morel.
Annales de Limnologie ANLIB3, Vol. 21, No. 1, p 19-24, 1985. 4 tab, 15 ref.

Descriptors: *Mollusks, *Temperature effects, *Thermal stress, *Thermal pollution, Calcium, Animal populations, Population exposure, Aquatic animals.

When Potamopyrgus jenkinsi was subjected to rising temperatures, (1) juveniles were less resistant than the adults; (2) the winter generation were less resistant than the summer generations; (3) eucalcic individuals were more resistant than oligocalcic individuals; (4) adaptation of oligocalcic individuals to a eucalcic environment increased their thermal resistance; and (5) inversely, adaptation of eucalcic individuals to oligocalcic water decreased their thermal resistance. (Author's abstract)
W88-10462

FACTORS CONTROLLING ROTIFER ABUNDANCES IN A NORWEGIAN EUTROPHIC LAKE: AN EXPERIMENTAL STUDY,
Oslo Univ. (Norway). Dept. of Biology.
D. O. Hessen, and J. P. Nilssen.
Annales de Limnologie ANLIB3, Vol. 21, No. 2, p 97-105, 1985. 4 tab, 2 fig, 27 ref.

Descriptors: *Rotifers, *Population dynamics, *Ecosystems, *Eutrophic lakes, *Zooplankton, Predation, Aquatic animals, Animal populations, Hydrogen ion concentration, Fertilizers, Fish populations, Cladocera, Norway.

Strong oscillations in the rotifer community are frequently observed in eutrophic lakes, where rotifers are important components of the zooplankton community. Manipulations with increased level of fertilizers, presence or absence of fish, abundances of competitors (cladocerans) and predators (Asplanchna) were performed in polyethylene enclosures. The experiments provided evidence for pure eutrophication effects (e.g. elevated pH) and predation from Asplanchna as the main controlling factors. The influence from potential competitors such as Daphnia and Bosmina was found to be of less importance, at least during these short-term experiments. (Author's abstract)
W88-10463

VARIABILITY IN THE SPERMATHECAL SETAE OF POTAMOTHRIX HEUSCHERI (BRETSCHER) (OLIGOCHAETA, TUBIFICIDAE) IN LAKE NEMI AND NOTES ON THE RELATIONSHIP BETWEEN THIS SPECIES AND THE TROPHIC LEVEL OF LAKES (VARIABILITE DES SOIES SPERMATHECALES DE POTAMOTHRIX HEUSCHERI (BRETSCHER) (OLIGOCHAETA, TUBIFICIDAE) DANS LE LAC DE NEMI ET REMARQUES SUR LA RELATION ENTRE CETTE ESPECE ET LE DEGRE DE TROPHIE DES LACS),
Rome Univ. (Italy). Dept. of Animal and Human Biology.
M. Bazzanti, and M. Lafont.
Annales de Limnologie ANLIB3, Vol. 21, No. 2, p 107-115, 1985. 6 fig, 67 ref.

Descriptors: *Ecology, *Trophic level, *Lake Nemi, *Biogeography, *Lakes, *Oligochaetes, Aquatic animals, Ecosystems, Animal populations, Morphology, France, Italy, Eutrophication, DEomestic wastes, Adaptation, Species Diversity, Population dynamics.

Data are presented on variability in the spermathecal setae of the tubificid Potmothrix heuscheri (Bretscher) from Lake Nemi (Central Italy). A systematic study, based on the anatomy of the efferent apparatus of the male and morphology of the genital setae, indicates that there is an ecotype of this species in the lake. The distribution of P. heuscheri in French and Italian lakes, especially Lake Nemi, is discussed in order to clarify the problem posed by the ecological requirements of this species in lakes P heuscheri is found in Lake Nemi in association with other tubificid species well known for their pollution tolerance. (Friedmann-PTT)
W88-10464

OLIGOCHAETES OF A RIVER IN THE SOUTH ALPS, THE BUECH (LES OLIGOCHETES D'UNE RIVIERE DES ALPES DU SUD, LE BUECH),
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 5C.
W88-10465

FAUNISTIC STUDY OF CHIRONOMIDS (DIPTERA) OF THE UPPER NESTE D'AURE (CENTRAL PYRENEES): THE IMPACT OF HYDROELECTRIC SCHEMES (ETUDE FAUNISTIQUE DES CHIRONOMIDES (DIPTERA) DE LA HAUTE NESTE D'AURE (PYRENEES CENTRALES): IMPACT DES AMENAGEMENTS HYDROELECTRIQUES),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 6G.
W88-10466

OBSERVATIONS ON THE MIGRATION BEHAVIOR OF ALEWIFE (ALOSA ALOSA L.) IN THE ARTIFICIAL CANAL OF GOLFECH HYDROELECTRIC PLANT (OBSERVATIONS SUR LE COMPORTEMENT MIGRATOIRE DES ALOSES (ALOSA ALOSA L.) DANS LE CANAL ARTIFICIEL DE L'USINE DE GOLFECH),
Ecole Nationale Superieure Agronomique de Toulouse (France). Lab. d'Ichthyologie Appliquee.
For primary bibliographic entry see Field 6G.
W88-10467

BUDGET AND INPUT-OUTPUT MODEL FOR TOTAL PHOSPHORUS IN LAKE LEMAN (BILAN ET MODELE D'ENTREES - SORTIES DU PHOSPHORE TOTAL DANS LE LEMAN),
Geneva Univ. (Switzerland). Unite de Biologie Aquatique.
For primary bibliographic entry see Field 5B.
W88-10468

NUMERICAL SIMULATION OF PHYTOPLANKTON DYNAMICS IN A SUCCESSION OF WATER BODIES WITH SHORT RETENTION TIME ON THE RIVER LOT (SIMULATION NUMERIQUE DE LA DYNAMIQUE DU PHYTOPLANCTON DANS UNE SUCCESSION DE RESERVOIRS A FAIBLE TEMPS DE RETENTION SUR LA RIVIERE LOT),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
A. Dauta, and J. Capblancq.
Annales de Limnologie ANLIB3, Vol. 21, No. 3, p 203-212, 1985. 7 fig, 2 tab, 24 ref.

Descriptors: *Phytoplankton, *Aquatic populations, *Model studies, *Rivers, *Mathematical models, *Biomass, *Population dynamics, Simulation, Solar energy, Retention time, River Lot, Phosphorus, Nitrogen, Carbon, Nutrients, Ecosystems, Chlorophyll.

Changes in phytoplankton biomass in a succession of water bodies of the transformed course of the river Lot (France) are simulated by a numerical model that takes into account the influences of

discharge, solar energy and nutrient inputs. This model, in accordance with present knowledge of the physiology of planktonic algae, particularly describes changes in cellular composition (C, N, P and chlorophyll content) associated with nutrient availability. Calibration and validity of the model were tested by the comparison of simulation results with field data measured by following the same mass of water on its course downstream, first during a passage of 50 km and then during a passage of 200 km. (Author's abstract)
W88-10470

POPULATIONS OF CLADOCERA (CRUSTACEA), AS DESCRIBED BY THE HYDROLOGICAL FUNCTIONING OF STAGNANT WATERWAYS (LES PEUPLEMENTS DE CLADOCERES (CRUSTACES), DESCRIPTEURS DU FONCTIONNEMENT HYDROLOGIQUE DES BRAS-MORTS FLUVIAUX),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
C. Amoros, and D. Chessel.
Annales de Limnologie ANLIB3, Vol. 21, No. 3, p 227-240, 1985. 9 fig, 4 tab, 30 ref.

Descriptors: *Macrophytes, *Cladocera, *Bioindicators, *Rivers, *Classification, *Population dynamics, *Stagnant water, *Aquatic habitats, Rhone River, France, Hydrologic properties, Crustaceans, Chemical properties, Spatial distribution.

The descriptive value of cladoceran populations with reference to their environment is evaluated in spatial-temporal terms (time and space hierarchies and their interactions) with three successive phases: classification of stations in terms of their hydrological function (origin, quality and renewal of water, measured by physico-chemical parameters), analysis of spatial-temporal interactions at the level of cladoceran populations, then classification of stations in terms of their cladoceran populations. The study has been made on three stagnant sections of the Rhone, each differing in its relationship with the flowing waters of the river; each of the three biotopes had several stations at which physical-chemical and faunistic samples were taken. The comparison between the hydrological classification and the faunistic classification showed that the cladocerans has a descriptive power that was both functional and non-dependent on station; in effect, except for the large zones of open, deep water devoid of macrophytes, each population provided information not only on the station and vegetation, but also on the stagnant waterway and its total hydrological function. (Author's abstract)
W88-10471

MICRODISTRIBUTION OF EPILITHIC ALGAE ON THE STONES OF A CORSICAN STREAM, THE RIZZANESE (MICROREPARTITION DES ALGUES EPILITHIQUES SUR LES CAILLOUX D'UN TORRENT CORSE, LE RIZZANESE),
Aix-Marseille-3 Univ. (France). Lab. de Biologie Animale et Ecologie.
A. Cazaubon, and M. Loudik.
Annales de Limnologie ANLIB3, Vol. 22, No. 1, p 3-16, 1986. 5 fig, 8 tab, 22 ref.

Descriptors: *Algae, *Population distribution, *Statistical analysis, *Substrates, *Aquatic habitats, *Plant populations, *Ecosystems, *Plant growth, Streams, Corsica, Stones, Statistical analysis.

A study of the composition and structure of epilithic algal populations at several places on the same pebble revealed two groups: (1) on the downstream face and the center of the upper face of the stone; (2) on the upstream face and the center of the lower face of the stone. A statistical analysis showed that the population on the upper face, because of its greatest stability, was the most representative of the algal community of stony substrata. (Author's abstract)
W88-10472

PHYSICAL AND BIOLOGICAL STABILITY OF INTERSTITIAL HABITATS. CASE OF TWO STATIONS OF THE UPPER RHONE (STABILITE PHYSIQUE ET BIOLOGIQUE DES MILIEUX INTERSTITIELS. CAS DE DEUX STATIONS DU HAUT RHONE),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
M. Dole, and D. Chessel.
Annales de Limnologie ANLIB3, Vol. 22, No. 1, p 69-81, 1986. 5 fig, 18 ref.

Descriptors: *Ecosystems, *Aquatic habitats, *Stability, *Population dynamics, *Aquatic fauna, *Interstitial water, Biotopes, Hydrological aspects, Groundwater level, Rhone River, France, Variability, Alluvial aqquifers, Base floor, Temporal distribution.

A study of the stability of the interstitial biocenoses in the upper level strata of the alluvial groundwater table of the Rhone River (upstream from Lyon) was undertaken to observe the relation between the physical stability of biotopes and the influence of perturbation. Two interstitial stations were chosen on the upper Rhone: one of the stations is subjected to variations in its groundwater level and to the floods of the Ain River (Station 8); and the second station is only affected by phreatic influences. Station 8 is most exposed to hydrological variations and has a well-organized biocenose, which has low temporal variability. Identical changes in biotope conditions (1) do not produce notable variations in the biocenoses at station 8, and (2) constitute a perturbation to which fauna at station 10 react differently, according to their adaptations to the subterranean biotope. (Author's abstract)
W88-10473

IMPACT OF A SPATE ON THE COMMUNITY OF MACROINVERTEBRATES OF THE RIVER DURANCE. THE ROLE OF THE DRIFT IN THE RECONSTITUTION OF THE FAUNA IN THE MAIN CHANNEL (IMPACT D'UNE CRUE SUR LA COMMUNAUTE D'INVERTEBRES DE LA MOYENNE DURANCE. ROLE DE LA DERIVE DANS LA RECONSTITUTION DU PEUPLEMENT DU CHENAL PRINCIPAL),
Aix-Marseille-3 Univ. (France). Lab. de Biologie Animale et Ecologie.
G. Prevot, and R. Prevot.
Annales de Limnologie ANLIB3, Vol. 22, No. 1, p 89-98, 1986. 5 fig, 3 tab, 9 ref.

Descriptors: *Aquatic drift, *Benthic fauna, *Recolonization, *Aquatic animals, Population dynamics, Sampling, Flood plains, River Durance, France, Anabranches.

Drift samples taken simultaneously in the main and secondary channels of the river in the ploid after the spate have shown the importance of the drift in reconstitution of the main channel communities. One part of that drift proceeds from the flood plain temporarily colonized with scattered benthic organisms, while the other comes from the side channels. (Author's abstract)
W88-10475

MODELING OF PHYTOPLANKTON DEVELOPMENT IN A EUTROPHIC CHANNELIZED RIVER: LE LOT (FRANCE) (MODELISATION DU DEVELOPPMEMENT DU PHYTOPLANCTON DANS UNE RIVIERE CANALISEE EUTROPHE: LE LOT (FRANCE)),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
A. Dauta.
Annales de Limnologie ANLIB3, Vol. 22, No. 2, p 119-132, 1986. 7 fig, 7 tab, 34 ref.

Descriptors: *Phytoplankton, *Algae, *Model studies, *Eutrophic rivers, *Population studies, *Stream biota, Temperature effects, Nutrients, Cyanophyta, Chlorophyta, Eutrophication, River Lot, France, Mathematical modeling, Model studies, Diatoms, Biomass.

This model simulates the dynamics of a phytoplankton population with eight species in the lower course (310 km) of a eutrophic river in relation to temperature, light and nutrients. A catastrophe model was tested with the conditions for the appearance of a bloom of Cyanophyceae, its decline and its effects on other species; the model generated phases of development and decline that were identical to those observed in the natural environment. Similarly, changes in the composition of the phytoplankton (diatoms, Cyanophyceae, Chlorophyceae) were reproduced. This model, based on laboratory estimates of specific growth rates of algae, provides a description of development conditions and succession for algae. (Author's abstract)
W88-10476

MOLLUSKS OF TIGNES LAKE (SAVOIE): THEIR USEFULNESS IN CHARACTERIZING WATER QUALITY IN HIGH ALTITUDE LAKES (LES MOLLUSQUES DU LAC DE TIGNES (SAVOIE): INTERET DE CE GROUPE FAUNISTIQUE POUR CARACTERISER LA QUALITE BIOLOGIQUE DES SEDIMENTS DES LACS D'ALTITUDE,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France).
For primary bibliographic entry see Field 5A.
W88-10477

SIMULIIDAE (DIPTERA: NEMATOCERA) OF THE NESTE D'AURE (CENTRAL PYRENEES) I. THE IMPACT OF HYDROELECTRIC SCHEMES IN THE UPPER VALLEY (LES SIMULIIDAE (DIPTERA: NEMATOCERA) DE LA NESTE D'AURE (PYRENEES CENTRALES). I. IMPACT DES AMENAGEMENTS HYRODELECTRIQUE DANS LA HAUTE),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 6G.
W88-10478

GENERAL PRINCIPLES FOR A METHOD OF ASSESSING THE OVERALL QUALITY OF LACUSTRINE SEDIMENTS, USING A SIMPLIFIED ANALYSIS OF THE MOLLUSK COMMUNITY,(PRINIPES GENERAUX POUR UNE METHOD D'APPRECIATION DE LAT QUALITE GLOBALE DES SEDIMENTS LACUSTRES A L'AIDE D'UNE ANALYSE SIMPLIFIEE DES MALACOCENOSES),
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France).
For primary bibliographic entry see Field 5A.
W88-10479

SEDIMENT-WATER EXCHANGE OF PHOSPHORUS. THE INFLUENCE OF SEDIMENT DILUTION ON RADIOTRACER KINETICS (ECHANGES DE PHOSPHORE ENTR LES SEDIMENTS ET L'EAU. INFLUENCE DE LA DILUTION SUR LES CINETIQUES DE TRACAGE ISOTOPIQUE),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 7B.
W88-10480

AQUATIC MICROHABITATS OF THE BANKS OF A LARGE WATER COURSE: THE FAUNISTIC APPROACH (LES MICROHABITATS AQUATIQUES DES RIVES D'UN GRAND COURS D'EAU: APPROCHE FAUNISTIQUE),
Lyon-1 Univ., Villeurbanne (France). Section of Freshwater Ecology.
M. Bournaud, and L. Cogerino.
Annales de Limnologie ANLIB3, Vol. 22, No. 3, p 285-294, 1986. 6 fig, 2 tab, 26 ref.

Descriptors: *Stream banks, *Macroinvertebrates, *Aquatic habitat, *Aquatic populations, *Stream biota, *Lotic environment, Aquatic habitats, Population density, Rhone River, France, Classification, Mollusks, Insects, Root zone, Oligochaetes, Lake sediments.

Sampling of the upper fringe of the submerged banks of the Rhone, upstream from Lyon, provided a new faunistic approach for the lotic environment. A complex mosaic of microhabitats forms

the bank and a non-exhaustive list of 19 microhabitats is proposed. A description of the sampling techniques for each microhabitat is provided. Finally, a correspondence analysis on a matrix of 35 surveys x 80 taxa shows that the microhabitats shelter faunistic communities that are effectively different and characterized by three environments of erosion, sedimentation and vegetation. The a priori definition of the microhabitats is therefore validated by the distribution of the macroinvertebrates. Several examples are given of invertebrates that are characteristic of the different microhabitats: Leptoceridae (Trichoptera) in the eroding microhabitat, Hydropsyche sp. in the plant roots, and oligochaetes in the sedimenting microhabitat. (Author's abstract)
W88-10481

ROLE OF CO2 IN LONG TERM STREAM ACIDIFICATION PROCESSES: A MODELING VIEWPOINT,
Institute of Hydrology, Wallingford (England).
C. Neal, and P. G. Whitehead.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 1,2, p 103-108, February 1988. 1 fig, 2 tab, 19 ref.

Descriptors: *Wales, *Carbon dioxide, *MAGIC model, *Model studies, *Acid rain, *Water chemistry, *Acidic water, Soil properties, Prediction, Groiundwater properties, Hydrogen ion concentration, Biomass, Weathering, Streams.

In this note the importance of accurately assessing CO2 levels for long-term acidification evaluation is demonstrated by the application of the MAGIC model to data for a semi-natural moorland site at Plynlimon, mid-Wales. The results of this study show two important features. Firstly the optimized values of soil parameters (base cation level, selectivity coefficients, weathering rates) in practice are similar for all the cases considered in that it is not possible to choose from measured soil data which, if any, of the results are appropriate. They nonetheless exhibit significantly lower cation weathering rates at the lowest CO2 value, and marked differences in the calculated selectivity coefficients. The higher stream pCO2 level seems to give the best agreement between predicted and observed stream water data but in general all the predictions are good. Secondly the long term stream pH trends show, up to the early 1970s, declining values with time although the extent of the decline varies according to the soil pCO2. In general the major decline occurs in the first half of this century. From the applied modeling perspective the MAGIC is very sensitive to soil and stream pCO2 variations. Diatom records can provide a valuable means of calibrating the model and estimating pCO2 values together with other key parameters such as weathering and biomass accumulation rates etc. Accurate assessment of the soil and stream pCO2 values is also required to give a much restricted, and hopefully realistic range for the weathering and selectivity coefficient estimates. (Alexander-PTT)
W88-10489

APPLICATION OF THE LINEAR PERTURBATION MODEL (LPM) TO FLOOD ROUTING ON THE MEKONG RIVER,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
For primary bibliographic entry see Field 2E.
W88-10494

SITE-SPECIFIC BARIUM TOXICITY TO COMMON DUCKWEED, LEMNA MINOR,
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 5C.
W88-10503

UNSUPERVISED LANDSAT CLASSIFICATION PROCEDURE APPLIED TO LAKE POSIONJARVI, NE FINLAND,
Oulu Univ. (Finland). Dept. of Astronomy.
For primary bibliographic entry see Field 7B.
W88-10508

CARBON DIOXIDE DYNAMICS IN MIRES RECLAIMED FOR FORESTRY IN EASTERN FINLAND,
Joensuu Univ. (Finland). Dept. of Biology.
J. Silvola.
Annales Botanici Fennici ABOFAQ, Vol. 23, No. 1, p 59-67, 1986. 5 fig, 1 tab, 45 ref.

Descriptors: *Wetlands, *Carbon cycle, *Forest hydrology, *Land reclamation, *Carbon dioxide, Finland, Drainage, Respiration, Forestry, Bogs, Peat bogs.

During four summers, the CO2 concentrations were measured in the air above mires reclaimed for forestry in eastern Finland. The daytime concentrations varied from 290 to 330 ppm. In the evening, with irradiation levels of 30-50 W per sq m, the CO2 values usually began to rise and were often around 450-600 ppm at sunrise. This increase in concentration was sometimes partially or wholly prevented by the wind. The nocturnal CO2 outputs of the different components of the system were calculated for one night. The total respiration rate at the beginning of the rise in concentration in the evening was about 1 g CO2 per sq m per h. The cumulative CO2 output from 18.00 to 03.00 was ca. 6.5 g CO2 per sq m per h, of which 62% originated from the drained peat, 21 from the surface vegetation and 17% from the aerial parts of the tree. In virgin mires the carbon accumulation averages about 15 g per sq m a, but after drainage the present mire began to release carbon at about 10 times this rate. Thus it seems that instead of accumulating carbon, large areas of peatland have altered in character and become a source of atmospheric carbon dioxide. (Author's abstract)
W88-10509

PAPER CHROMATOGRAPHY AS A METHOD OF PHYTOPLANKTON COMMUNITY ANALYSIS,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 7B.
W88-10510

LEVELS OF IRON, ALUMINUM, ZINC, CADMIUM AND MERCURY IN PLANTS GROWING IN THE SURROUNDINGS OF AN ACIDIFIED AND NON-ACIDIFIED LAKE IN ESPOO, FINLAND,
Helsinki Univ. (Finland). Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W88-10511

PLANKTON, CHLOROPHYLL CHARACTERISTICS AND FISHERY POTENTIAL OF SURFACE COAL MINE LAKES IN WESTERN PENNSYLVANIA,
Grove City Coll., Pa. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-10514

BENTHIC MACROINVERTEBRATES AS INDEXES OF WATER QUALITY IN THE UPPER CUYAHOGA RIVER,
Akron Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-10515

PURGEABLE ORGANICS IN GREAT LAKES RAW AND TREATED WATER,
Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W88-10530

UNSUBSTITUTED AND HYDROXY SUBSTITUTED FATTY ACIDS IN A RECENT LACUSTRINE SEDIMENT (LAKE LEMAN, GENEVA, SWITZERLAND),
Geneva Univ. (Switzerland). Mass Spectrometry Center.
Y. A. Mendoza, F. O. Gulacar, Z.-L. Hu, and A. Buchs.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 107-127, November 1987. 7 fig, 48 ref.

Descriptors: *Limnology, *Lake sediments, *Switzerland, *Lake Leman, *Fatty acids, *Paleolimnology, Chemical analysis, Diagenesis, Biological markers.

Unsubstituted as well as alpha-, beta-, omega- and (omega - 1)-hydroxy substituted fatty acids were analyzed in a 5 m long sediment core taken from Lake Leman (Switzerland). All these acids occur in three forms: unbound, bound and tightly bound. There is no conversion from one form to another. The fact that below a burial depth of 30 cm the abundance profiles show no decreasing trend indicates that the diagenetic reactions do not operate below that depth. Source correlations are postulated for each of the acid classes. The presence of unsubstituted monosaturated acids in the C20 to C32 range probably indicates that long chain fatty acids cannot be considered only as indicators of inputs from higher plants. C27, C29 and C31 (omega - 1)-hydroxyacids with unusual structures have also been found in these sediments, as well as 2-methyl nonacosanoic acid; their origin has not yet been established. (Author's abstract)
W88-10532

NOVEL IN SITU CASCADE ULTRAFILTRATION UNIT SPECIFICALLY DESIGNED FOR FIELD STUDIES OF ANOXIC WATERS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
For primary bibliographic entry see Field 7B.
W88-10534

BIOACCUMULATIVE BEHAVIOUR OF SOME PCB CONGENERS IN LAKE GENEVA BROWN TROUT (SALMO LACUSTRIS L.),
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. du Genie de l'Environment.
For primary bibliographic entry see Field 5B.
W88-10536

LIQUID CHROMATOGRAPHIC DETERMINATION OF CATIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES USING A CONTINUOUS POST-COLUMN ION-PAIR EXTRACTION DETECTOR WITH A SANDWICH PHASE SEPARATOR,
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W88-10540

ACCUMULATION OF COPPER AND COBALT BY BLUE-GREEN ALGAE AT DIFFERENT TEMPERATURES,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-10541

PURGE AND TRAP GAS CHROMATOGRAPHIC METHOD FOR DIMETHYL SULFIDE IN FRESHWATER,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 7B.
W88-10545

FISHES AND AQUATIC INSECTS OF NIPPERSINK CREEK, MCHENRY COUNTY, ILLINOIS,
Memphis State Univ., TN. Dept. of Biology.
O. T. Gorman.
Transactions of the Illinois Academy of Science TISAAH, Vol. 80, No. 3-4, p 233-252, 1987. 1 fig, 4 tab, 20 ref. Illinois Department of Transportation Project FAP0-420.

Descriptors: *Nippersink Creek, *Aquatic habitats, *Ecology, *Fish, *Aquatic insects, *Illinois, Surveys, Baseline studies, Streams.

A survey of the fishes and aquatic insects of Nippersink Creek, a tributary of the upper Fox River, McHenry County, Illinois, was conducted between September 1985 and July 1986. The aquatic fauna of Nippersink Creek is typical of clean, moderate gradient streams with minimal disturbance. A total of 41 fish species representing 10 families and 39 aquatic insect genera representing 24 families was collected. Twelve fish species represent new records for Nippersink Creek upstream of Spring Grove and 4 species represent new distributional records for the Fox Lake drainage. Karr's Index of Biotic Integrity indicates that the present fish fauna may be rated good to excellent quality. Similarly high ratings were found for the aquatic insect fauna using Hilsenhoff's Biotic Index. The high quality of the aquatic fauna and environmental conditions in Nippersink Creek contrast sharply with most northeastern Illinois streams. As such, Nippersink Creek represents a valuable natural resource for the region. (Author's abstract)
W88-10552

SURVEY OF THE FISHES AND MACROINVERTEBRATES OF SOME SMALL STREAMS IN COOK, LAKE, AND DUPAGE COUNTIES, ILLINOIS,
Memphis State Univ., TN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10553

IMPORTANCE OF STANDING DEAD SHOOTS OF THE NARROW LEAVED CATTAIL, TYPHA ANGUSTIFOLIA L.,
Smithsonian Environmental Research Center, Edgewater, MD.
T. E. Jordan, and D. F. Whigham.
Aquatic Botany AQBODS, Vol. 29, No. 4, p 319-328, January 1988. 3 fig, 29 ref. NSF Grant BSR-8316948.

Descriptors: *Tidal marshes, *Aquatic plants, *Cattails, *Wetlands, *Plant growth, Dead shoots, Brackish water, Plant physiology, Natural disturbance, Aeration.

Field experiments in a brackish tidal wetland dominated by Typha angustifolia L. demonstrated that dead shoots provide vital aeration for rhizomes of dormant Typha. Cutting off or bending over dead shoots at the sediment surface lowered oxygen concentrations in rhizomes and lowered aboveground production and flowering in the following growing season. The effects were more severe the earlier in the dormant season treatments were applied. Cutting had a greater effect than bending. Cutting reduced the numbers of live stems appearing in the following growing season, but bending increased their numbers while still reducing aboveground biomass. Dead shoots can be bent over by wind or snow, destroyed by fire and cut off by ice movement or by muskrats building lodges. These natural disturbances can affect the growth and reproduction of Typha. (Author's abstract)
W88-10555

INTERNAL STRUCTURE OF DEEP-DWELLING NITELLA MEADOWS,
State Univ. of New York at Albany. Dept. of Biological Sciences.
R. G. Stross, J. Huvane, and R. C. Sokol.
Aquatic Botany AQBODS, Vol. 29, No. 4, p 329-345, January 1988. 7 fig, 1 tab, 35 ref.

Descriptors: *Light effects, *Limnology, *Nutrients, *Plant growth, *Ecology, *Lakes, Meadows, Eutrophication, Lake George, New York.

Depth gradients of charophyte shoots, oospores and biomass were analyzed in 2 trophically divergent basins of Lake George, NY. Six taxa of charophytes inhabit the meadows. In the north basin, the meadows extend from 8 to 16 m. Internal transitions of species exist. Nitella furcata (Roxb. ex Bruz) Ag. comprised 85% of the shoots near the shallow margin and gave way gradually to N. flexilis (L.) Ag. (and N. opaca (Bruz.) Ag.) at 11.5 m and deeper. In the more eutrophic south basin where the meadow extends from 7 to 12 m, the shallow association of charophytes was displaced shoreward by N. flexilis. Small amounts of N. furcata persisted near the shallow margin. Several features relate to an assumed light control of the lower boundary. Oospheres, as propagules, are abundant in the sediments beneath the meadow and extend above the shallow margin and beyond the deep margins. Internal species transitions, possibly light sensitive, seem to be displaced shoreward in response to nutrient enrichment. Biomass accumulation was variable, independent of depth and sensitive to variables that include eutrophication. Structural details expose the sensitivity of Nitella meadows to disturbance. (Author's abstract)
W88-10556

EFFECT OF ACIDIFICATION ON MOBILITY OF HEAVY METALS AND ALUMINUM IN FOREST AND LAKE ECOSYSTEMS (HAPPAMOITUMISEN VAIKUTUS RASKASMETALLIEN JA ALUMIININ LIIKUVUUTEEN METSA-JA JARVIEKO SYSTEEMISSA),
Helsinki Univ. (Finland).
For primary bibliographic entry see Field 5B.
W88-10560

ESTIMATION OF WATER QUALITY AND NUTRIENT LOADS IN THE HII RIVER BY SEMI-DAILY SAMPLING,
Shimane Prefectural Inst. of Public Health and Environmental Science, Matsue (Japan).
For primary bibliographic entry see Field 2E.
W88-10572

COPPER (II) COMPLEXING CAPACITY OF LAKE HARUNA WATER, (IN JAPANESE),
Gunma Inst. of Public Health (Japan).
M. Uchiyama, Y. Nakajima, T. Tomizawa, and H. Akaiwa.
Japanese Journal of Limnology RIZAA, Vol. 49. No. 1, p 19-25, January 1988. 8 fig, 3 tab, 20 ref.

Descriptors: *Japan, *Lakes, *Chemical properties, *Metal complexes, *Limnology, *Copper, *Heavy metals, Chemical reactions, Dissolved oxygen, Metabolites, Spectroscopy.

An easy and useful back-extraction method for measuring copper (II) complexing capacity (CuCC) was established and was used to study the CuCC of Lake Haruna water. Using the ultrafiltration technique, it was found that dissolved organic materials having high CuCC were distributed in less than the 10,000 molecular weight range, and CuCC/DOC (Dissolved Organic Carbon) was the highest in the 1,000-10,000 molecular weight range. The CuCC/DOC of Lake Haruna water was 0.06-0.08, which was almost similar to the values of other lakes previously reported. Regarding the relation between the molecular weight distribution and the CuCC value, similar tendencies were observed for metabolic products in the growth of Chlorella sp. This consistency might indicate that the algal products are very important in evaluating the CuCC of such as Lake Haruna into which artificial pollutants do not flow. A positive relationship was observed between absorbance at 260 nm and CuCC both in Lake Haruna waters and in the Chlorella sp. experiment. (Author's abstract)
W88-10573

PRELIMINARY STUDY ON N2O PRODUCTION THROUGH NITRIFICATION IN LAKE KIZAKI,
Nagoya Univ. (Japan). Water Research Inst.
M. Yoh, H. Terai, and Y. Saijo.
Japanese Journal of Limnology RIZAA, Vol. 49. No. 1, p 43-46, January 1988. 3 fig, 13 ref.

Descriptors: *Lakes, *Chemical reactions, *Nitrogen cycle, *Nitrous oxide, *Dissolved oxygen, *Nitrification, *Hypolimnion, Seasonal variation, Japan.

In the hypolimnion of Lake Kizaki, an increase of N2O concentration was observed with time, concomitant with an increase of NO3(-) concentration and a decrease of oxygen concentration. In addition, the amount of apparent N2O production (delta N20) was found to be linearly correlated with that of apparent oxygen consumption (-delta O2). These facts suggest that N2O was produced during the process of nitrification in the hypolimnion of Lake Kizaki. The mole fraction of delta N20/-delta O2 was found to be 0.00027, consistent with the value of 0.0001, obtained by Yoshinari in the western North Atlantic Ocean. (Author's abstract)
W88-10575

PHYTOPLANKTON PRODUCTIVITY AND CHLOROPHYLL-A CONCENTRATION OF OGUTA LAKE IN SOUTHEASTERN NIGERIA,
Port Harcourt Univ. (Nigeria). Dept. of Zoology.
C. S. Nwadiaro, and E. O. Oji.
Hydrobiological Bulletin HYBUD9, Vol. 19, No. 2, p 123-131, December 1986. 4 fig, 1 tab, 43 ref.

Descriptors: *Lakes, *Nigera, *Oguta Lake, *Aquatic Productivity, *Phytoplankton, *Chlorophyll a, *Limnology, Seasonal variation, Physical properties, Aquatic habitats, Aquatic plants, Aquatic animals, Water chemistry, Nigeria.

The phytoplankton productivity and chlorophyll-a concentration of Oguta Lake, the largest natural lake in south-eastern Nigeria (Dec. 1983-Nov. 1984), are presented. The gross productivity ranged from 1.3 to 3.77 g C/sq m/day for the water column, dropped during the period of heavy rainfall and varied with depth. The chlorophyll-a concentration had monthly means ranging from 2.31 to 4.00 mg/cu m, with a drop during the rains, but little depth variation. Both productivity and chlorophyll-a showed non-significant correlation with the physico-chemical features of the water. The values of the biological parameters showed the lake as mesotrophic. The values are compared with those of other African lakes. (Author's abstract)
W88-10576

LITTORAL SAND ZOOBENTHOS AND ITS RELATION TO ORGANIC POLLUTION IN LAKE NEMI (CENTRAL ITALY),
Rome Univ. (Italy). Dept. of Animal and Human Biology.
For primary bibliographic entry see Field 5C.
W88-10577

DISTRIBUTION OF MACROINVERTEBRATES IN THE SHALLOW PART OF 'DE GIJSTER', A WATER STORAGE LAKE IN THE BIESBOSCH (THE NETHERLANDS),
Rijksmuseum van Natuurlijke Historie, Leiden (Netherlands).
For primary bibliographic entry see Field 5G.
W88-10578

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): I. GEOGRAPHICAL DESCRIPTION, HYDROGRAPHIC COMPONENTS AND MAN'S IMPACT,
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
E. Bajkiewicz-Grabowska.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 173-200, 1985. 17 fig, 9 tab, 10 ref.

Descriptors: *Rivers, *John River, *Limnology, *Lakes, *Geography, *Cycling nutrients, *Poland, Geohydrology, Watersheds, Watercourses, Runoff, Human impact.

Physical-geographic conditions are presented for the watershed of the Jorka River with particular emphasis placed on those factors of the geographic environment which affect the water and nutrient cycles in the watershed and the habitat features of the lakes. The description covers morphometric conditions of the watershed, as well as lithological, climatic and hydrographic conditions. With this background the potential is shown for the surface runoff to watercourses and lakes. On the basis of numerous indices the possible effect of the watershed on the particular water bodies has been deter-

mined. (See W88-10591 thru W88-10600) (Author's abstract)
W88-10590

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): II. HYDROLOGICAL BUDGET OF LAKES IN 1978 AND 1979,
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
E. Bajkiewicz-Grabowska.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 201-223, 1985. 15 fig, 1 tab, 5 ref.

Descriptors: *Limnology, *Surface-groundwater relations, *Jorka River, *Lakes, *Cycling nutrients, *Hydrologic budget, *Poland, Nutrient budget, Watersheds, Seasonal variations, Seepage.

A description is presented of the water cycle in four lakes of the Jorka River watershed: Majcz Wielki, Inulec, Glebokie and Jorzec. Particular attention is given to seasonal variation of water cycle components, such as inflow to lakes (including inflow by the River Jorka, inflow by secondary streams, and inflow from the immediate lake basin), river outflow from the lakes, magnitude of underground feeding of the lakes, and changes in the volume of water retained in lakes' basins. A summary of detailed water budgets of the lakes made it possible to assess the water exchange rate during the year and to follow its seasonal variations. (See also W88-10590) (Author's abstract)
W88-10591

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): III. IMPACT OF MAN ON THE MATTER INPUT AND SEDIMENTATION IN THE PAST,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W88-10592

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): IV. HEAVY METALS IN RECENT LACUSTRINE SEDIMENTS,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W88-10593

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): V. NUTRIENT INPUT WITH AIR TRANSPORT,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W88-10594

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VI. NUTRIENT INPUT WITH WATER TRANSPORT,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W88-10595

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VII. INPUT AND REMOVAL OF NUTRIENTS WITH FISH,
Lodz Univ. (Poland). Inst. of Environmental Biology.
For primary bibliographic entry see Field 5B.
W88-10596

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VIII. ZOOSYRTHON IN THE TRIBUTARIES AND OUTLET OF LAKE JORZEC,
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
S. Radwan, C. Kowalczyk, W. Zwolski, W. Kowalik, and B. Stepien.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 311-328, 1985. 5 fig, 6 tab, 21 ref.

Descriptors: *Limnology, *Jorka River, *Rivers, *Ecosystems, *Poland, *Biomass, *Lakes, Chemical composition, Tributaries, Aquatic animals, Watersheds, Zoosyrthon, Poland, Lake Jorzec, Potassium, Nitrogen, Phosphorus, Calcium, Magnesium.

Studies on the chemical composition of syrthon in the tributaries and outlet showed distinct differences in average weight ratios of mineral components introduced into components taken out of Lake Jorzec. For dry weight the ratio is 8:1, for total ash 21:1, for Ca 5:1, for Mg 11:1, for K 60:1, for total N 7.5:1, and for P 8.5:1. The biotic structure of zoosyrthon was qualitatively and quantitatively abundant and varied considerably in particular watercourses connected with the lake. Altogether 387 taxa were distinguished: 251 taxa (85.2%) for aquatic fauna and 36 taxa (14.8%) for terrestrial elements. (See also W88-10590) (Author's abstract)
W88-10597

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): IX. THE EXCHANGE OF PHOSPHORUS BETWEEN SEDIMENTS AND WATER,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W88-10598

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): X. ROLE OF THE MUSSEL DREISSENA POLYMORPHA (PALL.) IN N AND P CYCLES IN A LAKE ECOSYSTEM,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
A. Stanczykowska, and M. Planter.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 345-356, 1985. 3 fig, 6 tab, 12 ref.

Descriptors: *Poland, *Limnology, *Jorka River, *Lakes, *Cycling nutrients, *Mussels, *Rivers, *Bioaccumulation, Watershed, Nitrogen, Phosphorus, Dreissena.

The role of populations of the mussel Dreissena polymorpha in N and P cycles in five lakes of the Jorka River watershed was determined. Comparisons were made to establish what amounts of N and P have accumulated in mussels in each of the lakes under study. The largest quantities were found in Lake Majcz Wielki, a mesotrophic water body. For the same lake the shortest nutrient 'partial turnover time' was found by assessing the filtration processes. The role played by the mussels in nutrient cycles is of the same magnitude as that of macrophytes. (See also W88-10590) (Author's abstract)
W88-10599

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): XI. NUTRIENT BUDGET WITH SPECIAL CONSIDERATION TO PHOSPHORUS RETENTION,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
W. Lawacz.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 357-381, 1985. 11 fig, 3 tab, 52 ref.

Descriptors: *Limology, *Jorka River, *Path of pollutants, *Poland, *Lakes, *Nutrients, *Eutrophication, *Phosphorus, Rivers, Watersheds, Nitrogen, Carbon, Dusts, Fish farming.

Annual budgets of carbon, nitrogen and phosphorus were presented for 3 eutrophic lakes with different external inputs of these elements. Taken into account in the budgets were atmospheric transport (rainfall and dust), point water input, and in one of the study lakes inputs from rainbow trout lake culture. For phosphorus, monthly budget sheets were drawn up including internal loadings as well as sedimentation estimated by the trap method. The value has been compared with internal loading as assessed by 3 different methods. (See also W88-10590) (Author's abstract)
W88-10600

SESTON OF THE WARSAW REACH OF THE VISTULA RIVER IN 1982 AND 1983: I. CHLOROPHYLL AND ENVIRONMENTAL CONDITIONS,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
A. Kowalczewski, M. Perlowska, and J. Przyluska.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 389-405, 1985. 9 fig, 14 ref.

Descriptors: *Limnolgy, *Vistual River, *Rivers, *Poland, *Algae, *Eutrophication, *Environmental effects, Chlorophyll, Biomass, Phosphorus, Pheo pigments, Temperature, Conductivity, Light.

Concentrations of chlorophyll, pheopigments and phosphates were analyzed in the Vistula River at the Poniatowski Bridge in Warsaw (Poland) as well as the quantity of light falling on a horizontal surface, the temperature of water, its oxygenation, electrolytic conductivity and the rate of flow. Seasonal variability and variability in short time intervals were determined for these parameters. The biomass of algae showed positive dependence on temperature of waters and a negative one on phosphate concentration and river flow. (See W88-10602 thru W88-10603) (Author's abstract)
W88-10601

SESTON OF THE WARSAW REACH OF THE VISTULA RIVER IN 1982 AND 1983: II. DRY WEIGHT AND ORGANIC CARBON,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
A. Kowalczewski, M. Perlowska, and J. Przyluska.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 423-438, 1985. 9 fig, 26 ref.

Descriptors: *Vistula Rivers, *Rivers, *Seston, *Organic carbon, *Poland, *Eutrophication, *Water pollution, Organic matter, Pheopigments, Plankton.

From the Warsaw reach of the Vistula River seston was sampled at least once a week for 2 years. Concentrations of the seston dry weight (SDW), particulate (POC) and dissolved organic carbon (DOC) were analyzed. The pheopigment concentrations and seston respiration (SR) were determined. For all these parameters the seasonal and short-term changes were evaluated. The contribution of planktonic and nonplanktonic fractions of SDW and POC were calculated. The daily loads of SDW, POC and DOC of the Vistula in Warsaw were calculated. (See W88-10601 and W88-10603) (Author's abstract)
W88-10602

SESTON OF THE WARSAW REACH OF THE VISTULA RIVER IN 1982 AND 1983: III. PHYTO- AND ZOOPLANKTON,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
A. Kowalczewski, M. Perlowska, and J. Przyluska.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 423-438, 1985. 9 fig, 26 ref.

Descriptors: *Poland, *Vistula River, *Biomass, *Rivers, *Seston, Phytoplankton, Zooplankton, Primary productivity, Photosynthesis, Respiration.

From phytoplankton samples taken once a week for 2 years from the Vistula River in Warsaw, the following seston parameters were analyzed: seasonal variability, variability in short time intervals of total phytoplankton numbers in the Vistula, its composition, primary production, assimilation number, ratio of seston production to respiration

(P:R), changes in zooplankton numbers, and the contribution of taxonomic groups to zooplankton. Factors which may affect these seston parameters are indicated. (See W88-10601 thru W88-10602) (Author's abstract)
W88-10603

PHYTOSESTON OF THE VISTULA RIVER BETWEEN GORA KALWARIA AND NOWY DWOR MAZOWIECKI IN 1982,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W88-10604

COMPOSITION, PARTICLE SIZE AND ORGANIC MATTER CONTENT OF THE BOTTOM SEDIMENTS OF MAN-MADE LAKE ZEGRZYNSKIE,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
Z. Olszewski, and G. Mowinska.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 481-497, 1985. 7 fig, 22 ref.

Descriptors: *Limnology, *Lake Zegrzynskie, *Poland, *Reservoirs, *Lakes, *Eutrophic lakes, *Sediments, Detritus, Rivers, Lake sediments, Particle size, Organic matter, Dams.

Bottom sediments in man-made Lake Zegrzynskie, a lowland, eutrophic reservoir, were studied. Near the dam, the fraction of particles <0.2 mm dominated was predominant in the detritus. In the remaining area studied a mineral component with varying proportions of particle-size fractions were predominant in the sediments. The content of organic matter in the sediments ranged from 0.1 to 12.9% of the dry weight; the highest values were found for the sediments of the overflow area and near the dam. (See also W88-10604) (Author's abstract)
W88-10605

MEIBENTHOS OF MAN-MADE LAKE ZEGRZYNSKIE,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
K. Prejs, and B. Bernard.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 499-509, 1985. 5 fig, 3 tab, 20 ref.

Descriptors: *Limnology, *Lake Zegrzynskie, *Reservoirs, *Poland, *Eutrophic lakes, *Benthic fauna, *Lakes, Man-made lake, Meibenthos, Nematodes, Rivers.

Composition, numbers, and dominance of meibenthos of Zegrzynskie reservoir were analyzed between May and October 1982. Stations on backwaters of the Bug and Narew rivers were much less abundant in meibenthos than those in the central and lower parts of the reservoir. The numbers of meibenthos in these environments were high (max. 426,000 individuals/sq m). The main meibenthos components at the majority of stations were nematodes: 40-82% of the total numbers. (See also W88-10605) (Author's abstract)
W88-10606

EFFECT OF IMPOUNDMENTS ON THE QUALITY OF WATER AND BIOCOENOSIS IN THE LOWLAND STREAMS RAWKA AND SKIERNIEWKA - SUMMER ASPECT,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
R. J. Wisniewski, Z. Kajak, L. Bownik-Dylinska, J. Ejsmont-Karabin, and K. Prejs.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 511-536, 1985. 6 fig, 12 tab, 9 ref.

Descriptors: *Limnology, *Dam effects, *Poland, *Reservoirs, *Streams, *Water quality, Water exchange, Biocenosis, Phosphorus, Chlorophyll, Suspended sediments, Rauka River, Skierniewka River..

In the summer of 1981 (between June and September) the chemical composition of water and bottom sediments as well as the structure, density and biomass of communities of live organisms were studied in five impoundments on the lowland streams Rawka and Skierniewska. In impoundments with a water exchange from 2 to 50 hours, concentrations of suspended matter, phosphorus and chlorophyll in water changed as well as the structure and abundance of communities of organisms in comparison with free-running parts of streams above the impoundments. The character of these changes was connected with the time of water exchange. (Author's abstract)
W88-10607

STRUCTURE OF PHYTOPLANKTON IN RIVERS AND IN LAKES OF NORTHEASTERN POLAND.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
Z. M. Gliwicz, P. Dawidowicz, and J. Pijanowska.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 537-546, 1985. 3 fig, 2 tab, 11 ref.

Descriptors: *Poland, *Limnology, *Aquatic habitats, *Rivers, *Lakes, *Phytoplankton, Zooplankton, Comparison studies, Feeding habits.

Data collected during two days at the beginning of summer 1981 at 69 river and lake stations indicated substantial differences in taxonomic composition and in size distribution of phytoplankton, and in the abundance of zooplankton in river and lake habitats. The share of net algae above 20 micrometers in size in the total phytoplankton standing crop was significantly lower in rivers than in lakes. This coincides with much less abundant zooplankton in river habitats that is composed of less efficient filter feeding species than in lake habitats. (Author's abstract)
W88-10608

POLLUTION OF SURFACE WATERS IN AN AGRICULTURAL WATERSHED ON THE EXAMPLE OF THE SUCHA RIVER.
Institute of Meteorology and Water Management, Warsaw (Poland).
For primary bibliographic entry see Field 5B.
W88-10609

PLANKTONIC BLUE-GREEN ALGAE OF LAKES IN NORTH-EASTERN POLAND,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
I. Spodniewska.
Ekologia Polska ELPLBS, Vol. 34, No. 2, p 151-183, 1986. 9 fig, 1 tab, 65 ref.

Descriptors: *Poland, *Limnology, *Lakes, *Cyanophyta, *Phytoplankton, *Lakes, Biomass, Pollution, Algae.

Seasonal changes in composition and biomass of blue-green algae were examined in several lakes in northeastern Poland. The changes in biomass of blue-green algae at the spring and summer peak of phytoplankton development were characterized in several tens of dimictic and polymictic lakes differing as to morphometric characters, fertility and degree of pollution. The tendencies of changes over many years in the development of blue-green algae are discussed with consideration of the composition of dominant species, the biomass of community, as well as their contribution to total phytoplankton biomass. (Author's abstract)
W88-10610

EFFECT OF INDUSTRIAL POLLUTION ON LAKE EWINGI (MASURIAN LAKELAND) ESTIMATED BY REMOTE SENSING TECHNIQUES,
Instytut Ksztaltowania Srodowiska, Warsaw (Poland).
For primary bibliographic entry see Field 5A.
W88-10611

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: I. INTRODUCTION,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
E. Krzyzanek, and A. Kownacki.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 307-312, 1986. 4 fig, 10 ref.

Descriptors: *Limnology, *Goczalkowice Reservoir, *Reservoirs, *Ecosystems, *Poland, History, Research facilities.

The scientific objectives of the Hydrobiological Station at Goczalkowice and a short history of the studies of the Goczalkowice reservoir are presented. The history of the reservoir development scheme, the personnel involved in hydrobiological research, and a guide to the literature are discussed. (See W88-10613 thru W88-10628) (Author's abstract)
W88-10612

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: II. CHARACTERISTICS OF THE CATCHMENT AREA,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
H. Kasza.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 313-322, 1986. 5 fig, 10 ref.

Descriptors: *Limnology, *Goczalkowice Reservoir, *Poland, *Catchment areas, *Dams, *Reservoirs, *Water quality, Soils, Geology, Morphometry, Geohydrology.

The Goczalkowice dam reservoir catchment area Poland is described on the basis of existing literature data. Characteristics of the morphology, geological and soil structure, hydrology and development of the catchment area are presented. (See also W88-10612) (Author's abstract)
W88-10613

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: III. CHARACTERISTICS OF THE RESERVOIR AND ITS USEFULNESS TO WATER-SUPPLY SYSTEMS,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
J. Winohradnik.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 323-341, 1986. 6 fig, 7 tab, 13 ref.

Descriptors: *Limnology, *Goczalkowice Reservoir, *Water supply development, *Reservoirs, *Reservoir operation, *Poland, *Water quality, *Eutrophication, Dams, Water conveyance, Hydrology.

The Goczalkowice dam reservoir was built to confine and keep back water freshets and use them in periods of low-water states, as well as to serve as a water intake to be used by water supply systems. On the basis of data from 26-year investigations on the hydrology, changes in the basic water-quality indicators due to the stabilization process, and on the progressing eutrophication of the reservoir, a short description of its water is given from the viewpoint of its utility in water-supply systems. (See also W88-10612) (Author's abstract)
W88-10614

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: IV. METEOROLOGICAL CONDITIONS,
Polish Academy of Sciences, Chybie. Fish Culture Experimental Station.
D. Augustyn.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 343-350, 1986. 4 fig, 1 ref.

Descriptors: *Limnology, *Meteorology, *Reservoirs, *Ecosystems, *Goczalkowice Reservoir, *Poland, Weather, Climates, Air temperature, Rainfall.

Basic meteorological elements that affect the environment of the Goczalkowice Reservoir (Poland) and biotope, namely air temperature, insolation, wind direction and velocity, and precipitation, are described. Mean annual air temperature for the

study period was 8.0 C; it varied between 6.9 and 8.9 C. The greatest insolation irregularity was found for December, the irregularity index for the study period being 9.6; the lowest irregularity index - 1.9 was found in the summer months. Cloudiness and air pollution reduced the theoretically possible insolation in a year by up to 32.5% and in the summer and in the summer months up to 40%. Winds from the west predominate over the reservoir, the proporation of winds from the southeastern direction being very small. Mean annual wind velocity comes up to 3.0 m/s varying between 2.7 and 3.6 m/s. Variation of precipitation above the reservoir on an average amounted to 107 mm. Ochaby station receives an average of 900 mm precipitation a year. The highest irregularity was observed in September. (See also W88-10612) (Brock-PTT)
W88-10615

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: V. SOLAR RADIATION PENETRATING THE RESERVOIR,
Polish Academy of Sciences, Chybie. Fish Culture Experimental Station.
M. A. Szumiec.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 351-355, 1986. 1 fig, 1 tab, 9 ref.

Descriptors: *Goczalkowice Reservoir, *Poland, *Reservoirs, *Eutrophication, *Solar radiation, *Limnology, Ecosystems, Spatial distribution, Optical properties, Rainfall.

Total solar radiation flux penetrating the water and its spectral distribution were measured with a limnoactinometer in the growing seasons of 1967 and 1969, falling on the period of already stabilized conditions in the reservoir. A low solar radiation transmission and increasing proportion of the green part of the solar spectrum in deeper water layers pointed to a eutrophic nature of the water body. In the warmest months radiation transmission decreased, with horizontal differences appearing only just after heavy rainfalls in the catchment area. (See also W88-10612) (Author's abstract)
W88-10616

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: VI. BOTTOM SOILS OF THE RESERVOIR (AS OF 1953),
Akademia Rolnicza, Krakow (Poland).
Z. Mazur, and T. Komornicki.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 357-363, 1986. 1 fig, 2 tab, 4 fig.

Descriptors: *Limnology, *Poland, *Reservoirs, *Soil types, Ecosystems, Bottom sampling.

The results of pedological investigations are briefly presented; they were made before flooding the Goczalkowice reservoir. Warp soils prevail (62% of the superficies) before arable podzolic soils (26%) and alluvial muck soils (12%). (See also W88-10612) (Author's abstract)
W88-10617

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: VII. HYDROCHEMISTRY,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
H. Kasza, and J. Winohradnik.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 365-395, 1986. 5 fig, 16 tab, 57 ref.

Descriptors: *Poland, *Limnology, *Water pollution sources, *Goczalkowice Reservoir, *Water chemistry, *Reservoirs, Chemical properties, Water quality, Eutrophication, Nutrients, Sediments, Nutrients, Long-term studies.

The physico-chemical properties of the water of the Goczalkowice reservoir and its effluents, the sediments, and the interstitial waters of the sediments have been described on the basis of literature data and the authors' own results from a 28-year period of hydrochemical studies of this dam reservoir. The load of nutrient compounds into the dam reservoir as well as the loading of its bottom with nutrients has been calculated. Changes in the chemical composition of the water during the study years, and the eutrophication of the water body are described. Nutrient content in its water has been found to be 2-3 times higher than about 20 years ago. (See also W88-10612) (Author's abstract)
W88-10618

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: VIII. PHYTOPLANKTON.
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
G. Pajak.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 397-413, 1986. 5 fig, 2 tab, 8 ref.

Descriptors: *Limnology, *Goczalkowice Reservoir, *Reservoirs, *Phytoplankton, *Poland, *Reservoirs, Ecosystems, Lakes, Limnology, Diatoms, Chlorophyta, Cyanophyta, Pyrrophyta, Long-term studies.

Qualitative and quantitative changes of the phytoplankton of the Goczalkowice dam reservoir (Vistula basin, southern Poland) during its 28 years' existence (1955-1982) are described. Dominant in the phytoplankton were at first Bacillariophyceae and Dinophyceae, then Bacillariophyceae and Chlorophyta; in recent years the importance of Cyanophyta has clearly increased. In the first years following the filling of the reservoir with water, plankton algae were found in high numbers and then grew again towards the late 1970s. (See also W88-10612) (Author's abstract)
W88-10619

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: IX. ZOOPLANKTON,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
W. Krzanowski.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 415-428, 1986. 8 fig, 23 ref.

Descriptors: *Limnology, *Poland, *Water level fluctuations, *Goczalkowice Reservoir, *Reservoirs, *Zooplankton, Lakes, Protozoa, Crustacea, Rotifers.

Zooplankton (Protozoa, Rotatoria, and Crustacea) of the Goczalkowice dam reservoir was investigated as regards its species composition, quantitative occurrence and changes between 1955 and 1982. Species diversity was considerable; zooplankton occurred abundantly, but decreased in successive years of the reservoir's existence. Two stages in zooplankton community development were distinguished: 1955-1962, when experimental flooding took place, and 1963-1982, when zooplankton numbers and diversity declined. The inflowing flood waters and considerable drawdowns of water level affected greatly the zooplankton development. (See also W88-10612) (Author's abstract)
W88-10620

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: X. MACROPHYTES.
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
T. Kuflikowski.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 429-445, 1986. 9 fig, 15 ref.

Descriptors: *Limnology, *Goczalkowice Reservoir, *Poland, *Reservoirs, *Macrophytes, Ecosystems, Long-term studies, Wetlands, Lakes.

The macrophyte formations in the Goczalkowice Reservoir over 28 years is described. Three stages in their development have been distinguished. The first stage (1956-1958) was characterized by a great growth of macrophytes and a small number of species. The second stage (1959-1972) showed a maximum growth of emergent macrophytes. The third stage, from 1973, showed further growth of macrophytes with submerged leaves and a stabilization of their dominance. (See also W88-10612) (Author's abstract)
W88-10621

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XI. EFFECT OF PAR ENERGY ON THE PLANT PHOTOSYNTHETIC PRODUCTION,
Polish Academy of Sciences, Krakow. Zaklad Fizjologii Rosiin.
M. Czarnowski, W. Maczek, and J. Pilarski.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 447-455, 1986. 8 fig, 12 ref.

Descriptors: *Limnology, *Reservoirs, *Goczalkowice Reservoir, *Poland, *Primary productivity, *Photosynthesis, Solar radiation, Ecosystems, Optical properties, Photosynthetically active radiation.

The photosynthetically active radiation (PAR) that reaches the water surface, its reflected part, and the radiation intensity gradient in relation to depth are described. The effect of the PAR energy on the photosynthetic activity and productivity of some aquatic plant species was determined in the laboratory. The highest rate of photosynthesis was found in S. sagittifolia (9 mg CO2/8 sq dm/hr). Phtotsynthetic production on N. luteum varied on different days between 20 and 80 mg CO2/sq dm/day. During the growing season, the effective photosynthetic production this species attained 7.5 g CO2/sq dm/season. (See also W88-10612) (Author's abstract)
W88-10622

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XII. ALGAL PERIPHYTON ON HIGHER PLANTS,
Polish Academy of Sciences, Krakow. Inst. of Botany.
T. Mrozinska.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 457-472, 1986. 9 fig, 2 tab, 29 ref.

Descriptors: *Poland, *Limnology, *Goczalkowice Reservoir, *Reservoirs, *Algae, *Aquatic plants, *Periphyton, Wind, Current, Aquatic habitats, Lakes, Ecosystems.

Results of studies conducted in 1961 in Goczalkowice Reservoir on periphyton on higher plants are presented. Overall 250 algal taxa were found. The occurrence of a diverse and well-established Hora of periphytic algae indicates stabilization of ecological conditions in the reservoir. The communities distinguished prove the great differentiation of the reservoir and especially of its littoral zone. Floristic differentiation of communities also was analyzed in relation to environmental conditions. Habitat zonation was sevident in terms of such factors as wind and current, with different algal floras in habitats of different physical characteristics. (See also W88-10612) (Author's abstract)
W88-10623

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XIII. PLANT-DWELLING FAUNA,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
T. Kuflikowski.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 473-489, 1986. 9 fig, 23 ref.

Descriptors: *Poland, *Limnology, *Goczalkowice Reservoir, *Macrophytes, *Reservoirs, *Invertebrates, Ecosystems, Benthic fauna, Plant populations, Midges, Aquatic habitats, Lakes.

Development dynamics and numbers of invertebrate fauna were examined on particular plant species occurring in great concentrations, i.e, on Batrachium aquatile (L.) Dum., Myriophyllum spicatum L., Polygonum amphibium L., Potamogeton lucens L., P. crispus L., Glyceria maxima Holm.

and Elodea canadensis Rich. Chironomidae dominated distinctly on all plants with the exception of E. canadensis. Seasonal dynamics of invertebrate fauna numbers varied. This fauna compared with benthic fauna of Goczalkowice reservoir showed that these are two different communities. (See also W88-10612) (Author's abstract)
W88-10624

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XIV. ZOOBENTHOS,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
E. Krzyzanek.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 491-513, 1986. 3 fig, 6 tab, 35 ref.

Descriptors: *Goczalkowice Reservoir, *Succession, *Limnology, *Reservoirs, *Benthos, *Poland, Lakes, Ecology, Aquatic habitats, Lotic environment, Midges, Lentic environment, Long-term studies.

The zoobenthos and the process of its formation during the 28-year existence of the Goczalkowice reservoir is described. Five stages are distinguished: the first was the year 1955, characterized by the recession of terrestrial and river fauna; the second (1956-1959), by a mass development of Chironomidae; the third (1960-1963), by the growth of other zoobenthic groups; the fourth (1964-1973), by a rapid decrease in numbers; the fifth (since 1974), by a new growth in numbers and a stabilized specific composition. (See also W88-10612) (Author's abstract)
W88-10625

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XV. ICHTHYOFAUNA,
Polish Academy of Sciences, Krakow. Zaklad Fizjologii Roslin.
J. Starmach.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 515-521, 1986. 1 fig, 3 tab, 6 ref.

Descriptors: *Goczalkowice Reservoir, *Succession, *Fish, *Dam effect, *Reservoirs, *Fish populations, *Ecosystems, *Poland, Roach, Pike, Bream, Long-term studies.

The succession of fish species in the Goczalkowice Reservoir is described for the period between the reservoir flooding and 1983. The changes in ichthyofauna composition were as follows: mass growth of pike (Esox lucius L.) between 1955 and 1960, of roach (Rutilus rutilus L.) between 1961 and 1965, and of bream (Abramis brama L.) which was a dominant species in the reservoir between 1966 and 1983. The formation of proper ichthyofauna for the Goczalkowice Reservoir lasted 15 years (1956-1971). At present the fish stock is stable and no greater changes are expected. (See also W88-10612) (Author's abstract)
W88-10626

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XVI. BIRDS,
Polish Academy of Sciences, Krakow. Zaklad Zoologii Systematycznej i Doswiadczalnej.
Z. Bochenski.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 523-535, 1986. 1 fig, 1 tab, 20 ref.

Descriptors: *Limnology, *Goczalkowice Reservoir, *Reservoirs, *Water birds, *Marsh birds, *Poland, Breeding, Wetlands, Eutrophic lakes, Succession, Bird populations, Aquatic habitats, Long-term studies.

Sixty-nine species of water and marsh birds were observed in the area of the Goczalkowice Reservoir. More than 30 of them were breeding species: the most interesting was the occurrence of Panurus biarmicus. The greatest variety of birds was observed in the season of autumnal migrations - Arenaria interpres, Calidris temmincki and C. testacea were met with. The process of formation of the breeding bird community was characteristically connected with habitat changes. Now the community of breeding birds most resembles those encountered on large eutrophic lakes. (See also W88-10612) (Author's abstract)
W88-10627

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XVII. GENERAL REGULARITIES,
Polish Academy of Sciences, Krakow. Zaklad Fizjologii Roslin.
A. Kownacki, and E. Krzyzanek.
Ekologia Polska ELPLBS, Vol. 34, No. 3, p 537-558, 1986. 4 fig, 50 ref.

Descriptors: *Goczalkowice Reservoir, *Reservoirs, *Ecosystems, *Poland, Limnology, *Eutrophication, *Aquatic life, Biocenosis, Water supply development, Lakes, Long-term studies.

The formation and succession of the Goczalkowice reservoir biocenoses are described on the basis of 28 years' continuous studies. Factors affecting the development of biocenoses are discussed, and biocenotic relationships in the reservoir itself and between the river and the reservoir are presented. As the reservoir is used by water-supply systems, measures are recommended aimed at controlling its further eutrophication. (See also W88-10612) (Author's abstract)
W88-10628

ABUNDANCE, DISTRIBUTION AND LIFE CYCLES OF MIDGES (CHIRONOMIDAE: DIPTERA) IN AN ACID STRIP-MINE LAKE IN SOUTHERN ILLINOIS,
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
S. J. Zullo, and J. B. Stahl.
American Midland Naturalist AMNAAF, Vol. 119, No. 2, p 353-365, April 1988. 7 fig, 2 tab, 39 ref.

Descriptors: *Lakes, *Midges, *Acid mine drainage, *Aquatic fauna, *Aquatic populations, *Water pollution effects, Acidic water, Population exposure, Biomass, Seasonal variations, Dredging, Sampling.

The chironomid population of an acid (pH 3) strip-mine lake was studied by taking pairs of Ekman dredge samples from five stations along one transect at fortnightly to monthly intervals for 1 year; only two species were found. For Chironommus near maturus the range (and annual mean) of larval numbers in the transect were 3055 to 14,137 (X = 3,936)/sq m, and maximum station density was 49,972/sq m. Range (and annual mean) of larval biomass in the transect were 4.15 to 19.78 g/sq m (X = 4.23) and maximum station biomass was 44.46 g/sq m preserved wet weight. In 1977 at the deepest (8 m) station, C. nr. maturus was usually abundant, but in 1978 it was scarce or absent. Chironomus nr. maturus was univoltine, but with part of the population emerging in the autumn and part in the spring and summer. The respective numbers for Tanytarsus dendyi were 0-17,352 (2,360) and 50,105/sq m; and respective weights were 0-1.20 (0.16) and 2.99 g/sq m. Tanytarsus dendyi was almost always scarce or absent at the deepest station. It was trivoltine; each summer generation lasted ca. 2 months. It overwintered in the egg stage or as first instar larvae. Abundance of both species was higher than for species in the same genera in most other acid and circumneutral lakes. The sparser populations in deep water in 1978 may be related to a strong stratification in which oxygen supersaturation persisted for several weeks at intermediated depths. (Author's abstract)
W88-10635

SPATIAL AND TEMPORAL AVAILABILITY OF FLOODPLAIN HABITAT: LONG-TERM CHANGES AT POOL 19, MISSISSIPPI RIVER,
Illinois Natural History Survey, Havana. River Research Lab.
J. W. Grubaugh, and R. V. Anderson.
American Midland Naturalist AMNAAF, Vol. 119, No. 2, p 402-411, April 1988. 5 fig, 1 tab, 40 ref. NSF Grant BSR-8114563.

Descriptors: *Ecosystems, *Flood plains, *Mississippi River, *Aquatic environment, *Aquatic habitats, Dams, Hydrologic cycle, Flood hydrographs, Levees.

The 107-year record of daily water elevations for the upper Mississippi River (UMR) at Burlington, Iowa, was examined to assess changes in hydrologic patterns and floodplain availability resulting from dam and levee construction. Following completion of Lock and Dam 19 in 1913, mean low, mean high and overall mean water levels significantly increased ($P < 0.05$). Floodplain habitat was permanently inundated. Establishment of extensive levee and drainage districts adjacent to Pool 19 resulted in additional loss of floodplain. Generalized annual hydrographs indicated the spring rise in water elevation had been shortened in the postdam period and an autumn rise evident in the predam hydrograph was absent in the postdam hydrograph. Temporal reduction in floodplain availability along with spatial losses caused by inundation and leveeing aggravates the situation for floodplain-dependent species. Detrimental consequences of floodplain loss can, however, be diminished through reduction of levee and drainage districts, thereby promoting interaction between floodplain habitat and the river system. (Author's abstract)
W88-10636

LIMNOLOGICAL INVESTIGATIONS ON THE AL-LATIFIYAH COMMON CARP (CYPRINUS CARPIO) POND (BAGHDAD-IRAQ): I. ENVIRONMENTAL CONDITIONS AND ZOOPLANKTON ABUNDANCE,
Biological Research Center, Baghdad (Iraq).
H. M. Mangalo, and M. M. Akbar.
Journal of Environmental Science and Health JESEDU, Vol. 23, No. 4, p 335-349, May 1988. 5 fig, 1 tab, 22 ref.

Descriptors: *Limnology, *Fish ponds, *Aquatic environment, *Zooplankton, *Animal populations, *Biomass, *Aquatic productivity, *Ecosystems, *Carp, Diversity, Ponds, Seasonal variations, Hydrogen ion concentration, Dissolved oxygen, Chlorophyll, Sampling, Iraq, Baghdad.

Environmental conditions and zooplankton abundance were recorded for eight months in common pond carp at Al-Latifiyah (Baghdad). Seasonal variations of some environmental factors were noted during the study period, among them water temperature, dissolved oxygen, pH, electrical conductance, chlorophyll a and light penetration. Seasonal quantitative and qualitative trends of zooplankton of the common pond carp (Cyprinus carpio) are reported. Most of the genera detected were Cladocerans (Scapholeberis kingi, Diaphanosoma brachyurum, Alona Costata, Moina affinis, Sida crystallina, Simocephalus vetulus, S. Expinosus, Chydorus sphearicus), with copepods (Cyclops, Diaptomus, and Canthocamptus), and Ostracoda (Cypria), being the second- and third-most frequently found zooplankton, respectively. Some of the genera were recorded through the study period but seasonally the highest number of species were found in April (ten species). Total number of species ranged from 2 to 10 during the sampling period. (Author's abstract)
W88-10640

TEMPERATURE, OXYGEN AND HEAT BUDGETS OF SIX SMALL WESTERN IRISH LAKES,
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
N. A. Allott.
Freshwater Biology FWBLAB, Vol. 16, No. 2, p 145-154, April 1986. 6 fig, 2 tab, 37 ref.

Descriptors: *Limnology, *Ireland, *Temperature, *Oxygen, *Lakes, *Heat budget, Thermocline, Thermal stratification, Limnology, Weather, Wind, Phytoplankton, Nutrients, Marine climates.

Temperature and oxygen were examined in six small western Irish lakes (areas 2-110 ha) in 1981,

1982, and 1984. The four deeper lakes stratify stably in the same manner as some well-known stratifying lakes in Britain. Windiness (due to proximity to the ocean) seems generally to be reflected in the lakes by the presence of a sharp thermocline. Considerable variation in the pattern of stratification occurs from year to year. Two shallow lakes stratify only in periods of warm, calm weather. Annual heat-budgets range from 4.1 kcal per square cm to 13.7 kcal per square cm. There is a strong linear relationship between mean-depth and annual heat-budget. Oxygen depletion is severe in the more productive lakes. (Author's abstract)
W88-10650

REGRESSION TECHNIQUE FOR THE ESTIMATION OF EPIPHYTIC INVERTEBRATE POPULATIONS,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
J. A. Downing.
Freshwater Biology FWBLAB, Vol. 16, No. 2, p 161-173, April 1986. 4 fig, 7 tab, 45 ref, append.

Descriptors: *Limnology, *Statistics, *Regression analysis, *Invertebrates, *Epiphytes, *Macrophytes, Biomass, Population density, Sampling, Costs, Ecology, Populations, Amphipods, Crustaceans, Aquatic insects.

A regression method is proposed for the estimation of populations of epiphytic invertebrates. Small samples of macrophytes and attached animals are taken by gentle enclosure. Regression analysis is used to relate the number of animals collected to the macrophyte species composition and biomass in these small samples. These relationships estimate the number of organisms of each taxon per unit mass of each macrophyte species. Areal population density is estimated by multiplication of macrophyte mass-specific invertebrate density by standing macrophyte biomass. The regression method yields population density estimates several times greater than the best of current methods for several fauna. Differences are most pronounced for active organisms such as water mites, amphipods, cladocerans, copepods, lepidopterans, ostracods, and trichopterans. Precision levels obtained using the regression methods are comparable to other techniques. The regression technique automatically provides estimates of macrophyte species-specific colonization density and the abundance of organisms swimming amoung macrophytes in littoral areas. (Author's abstract)
W88-10651

PUMP SAMPLER STUDY OF MICRODISTRIBUTION IN WALKER LAKE, ARIZONA, U.S.A.: A SENESCENT CRATER LAKE,
Northern Arizona Univ., Flagstaff. Dept. of Biology.
D. W. Blinn, and J. Green.
Freshwater Biology FWBLAB, Vol. 16, No. 2, p 175-185, April 1986. 9 fig, 1 tab, 24 ref.

Descriptors: Samplers, *Sampling, *Walker Lake, *Arizona, *Lakes, Pumps, Phytoplankton, Zooplankton, Thermocline, Dissolved oxygen, Water temperature, Stratification, Ecology, Diatoms, Seasonal variation, Dinoflagellates, Flagellates, Algae, Vertical distribution.

The seasonal microdistribution of physico-chemical features and plankton were examined at close intervals in a high elevation (2493 m) senescent crater lake (1 m deep) in the arid southwestern U.S.A. The protective volcanic rim and dense growth of Potomogeton natans provided highly stable thermal conditions throughout much of the year with the thermocline frequently in the top 30 cm of the water column during the summer and dissolved oxygen typically less than 3.0 mg per liter in surface waters and less than 1.0 mg per liter below 50 cm. The microdistribution of both phytoplankton and zooplankton was examined at close intervals (10 cm) throughout the water column with the aid of a peristaltic pump. Aglaodiaptomus leptopus, along with Dinobryon sertularia and certain diatom species, were largely restricted to the top 30 cm, while the colonial phytoflagellate, Pyrobotrys elongata and certain euglenoids were mostly located in the anaerobic lower strata. Cryptomonas obovata demonstrated subsurface maxima at various locations within the water column depending upon season. The distribution of plankton was also compared during daylight and darkness on one date. (Author's abstract)
W88-10652

COLLOIDAL AND DISSOLVED ORGANIC CARBON DYNAMICS IN UNDISTURBED BOREAL FOREST CATCHMENTS: A SEASONAL STUDY OF APPARENT MOLECULAR WEIGHT SPECTRA,
University Coll. of North Wales, Bangor. School of Animal Biology.
M. A. Lock, and T. E. Ford.
Freshwater Biology FWBLAB, Vol. 16, No. 2, p 187-195, April 1986. 3 fig, 1 tab, 22 ref.

Descriptors: *Dissolved organic carbon, *Rivers, *Forests, *Streams, Molecular Weight, Catchment areas, Metabolism, Water sampling, Statistical analysis, Seasonal variation, Chemical analysis, Quebec, Canada, Stream order, Longitudinal gradients.

Colloidal and dissolved organic carbon (CDOC) was monitored in six pristine boreal rivers in Northern Quebec, Canada, using ultrafiltration to obtain apparent molecular weight spectra. The concentration and proportional contribution of small (less than 1 K) molecular weight materials and high (0.7 um to 300 K) molecular weight material was not significantly different between streams of order 2-9. The dominant component of CDOC (0.7 um to 300 K fraction) was probably derived in streams other than first order, from surface or sub-surface run-off, whereas a peak concentration in the less than 1 K fraction during August was probably due to autochthonous exudates. The two first order streams included in this survey had very low CDOC concentrations. However, further work on twelve other first order streams showed that they had high CDOC concentrations, the is the more typical situation. The finding offered a potential explanation for the otherwise anomalous longitudinal CDOC distribution pattern throughout the study area. (Author's abstract)
W88-10653

PERIPHYTON COMMUNITIES IN A PRISTINE MOUNTAIN STREAM ABOVE AND BELOW HEAVY METAL MINING OPERATIONS,
Victoria Univ. (British Columbia). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10654

ANTARCTIC STREAM ECOSYSTEMS: PHYSIOLOGICAL ECOLOGY OF A BLUE-GREEN ALGAL EPILITHON,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
W. F. Vincent, and C. Howard-Williams.
Freshwater Biology FWBLAB, Vol. 16, No. 2, p 219-233, April 1986. 5 fig, 5 tab, 26 ref.

Descriptors: *Biomass, *Ecosystems, *Streams, *Antarctic, *Polar regions, *Algae, *Aquatic fungi, *Blue-green algae, Substrates, Sediments, Photosynthesis, Respiration, Water temperature, Epilimnion, Chlorophyll A, Physiological ecology, Biomass, Turbidity, Suspended sediment Primary productivity.

Several dozen summer meltwater streams are located in the McMurdo Sound region of southern Victoria Land. They are characterized by a highly variable flow regime at diel, seasonal and annual timescales; wide fluctuations in temperature and nutrient content; and a very simple epilithic community of cyanophytes, bacteria, fungi and microherbivores. In a series of artificial substrate experiments, biomass accumulation rates were generally less than 0.1 ln units per day. Colonization and growth on the substrates was inversely related to the suspended sediment load of the stream. There was also a visual correspondence between per cent algal cover of the natural streambed and the clarity of the streamwater. During running water conditions the mature communities had very low gross photosynthetic rates per unit chlorophyll and per unit carbon. Respiration was generally a high percentage of gross photosynthesis. The floristically simple epilithic mats slowly accumulate to extreme biomass levels. Production rates per unit biomass are low, probably in response to the cold temperatures of the Antarctic stream environment, and the accumulated biomass represents several seasons of growth. (Author's abstract)
W88-10655

FIELD TECHNIQUE FOR THE DETERMINATION OF ZOOPLANKTON GRAZING ON NATURAL BACTERIOPLANKTON,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
P. K. Bjornsen, J. B. Larsen, O. Geertz-Hansen, and M. Olesen.
Freshwater Biology FWBLAB, Vol. 16, No. 2, p 245-253, April 1986. 5 fig, 2 tab, 36 ref.

Descriptors: *Limnology, *Zooplankton, *Bacterioplankton, *Food habits, *Populations, *Bacteria, *Lakes, Time series analysis, Spatial distribution, Denmark, Sampling, Radioisotopes, Ecosystems, Isotope studies, Radioactive tracers, Errors, Statistics.

A method for the determination of zooplankton community grazing rates on natural populations of bacteria is described. Undisturbed zooplankton samples were incubated with 3H-thymidine-labelled bacterioplankton, and animals and their food subsequently separated by size. Prehandling of zooplankton by concentration before incubation reduced the grazing rates by a factor ranging from three to four. Time series experiments showed that appropriate incubation periods ranged from 40 min at 14 C to 60 min at 10. Spatial variability in the zooplankton was the main source of the overall standard error. This was considerably reduced by using composite samples. (Author's abstract)
W88-10656

FLUXES OF FREE AMINO ACIDS IN THREE DANISH LAKES,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
N. O. G. Jorgensen.
Freshwater Biology FWBLAB, Vol 16, No. 2, p 255-268, April 1986. 9 fig, 2 tab, 50 ref. Danish National Research Council Grants 11-308 and 11-2605.

Descriptors: *Denmark, *Amino acids, *Eutrophic lakes, Phytoplankton, Zooplankton, Ecosystems, Ecology, Dissolved solids, Grazing, Bacteria, Lakes.

Heterotrophic assimilation rates and concentrations of dissolved free amino acids (DFAA) were followed during diel studies in the eutrophic Lake Mosso, Lake Esrom and Lake Orn in spring and summer in 1982. In all three lakes, 3 to 4 fold diel variations in concentrations and assimilation rates were measured. These fluctuations appeared to be independent of phytoplankton and bacteria production. Pools of DFAA varied from 380 nm (Lake Mosso) to 2430 nm (Lake Orn), with serine, glycine, alanine and ornithine as dominant free amino acids. When similar water samples were incubated in a natural light-dark cycle or in total darkness, different pools of DFAA were measured in light and dark. Decomposition of organic matter or zooplankton activity appears to be responsible for the concentration changes. Observed discrepancies between simultaneous concentration changes and assimilation rates are discussed in relation to the applied tracer procedure and the concentration measurements. Assimilation of DFAA sustained from 6% to 25% of the bacterial carbon requirement, corresponding to 2-12% of the phytoplankton production in the lakes. (Author's abstract)
W88-10657

FIELD EXPERIMENTS ON THE RELATIONSHIP BETWEEN DRIFT AND BENTHIC DENSITIES OF AQUATIC INSECTS IN TROPICAL STREAMS (IVORY COAST): III. TRICHOPTERA,
Karlsruhe Univ. (Germany, F.R.). Zoologisches Inst.
B. Statzner, J. M. Elouard, and C. Dejoux.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 391-404, June 1987. 2 fig, 3 tab, 34 ref, append.

Descriptors: *Aquatic insects, *Field tests, *Caddisflies, *Aquatic drift, *Benthic environment, *Tropical regions, Diurnal distribution, Statistical analysis, In situ tests, Population dynamics, Multivariate analysis, Population density, Africa, Reproduction, Streams, Ivory Coast.

Based on in situ gutter trials, the drift of caddisflies were related to their benthic densities and to various abiotic factors in streams in the Ivory Coast (West Africa). Members of the families Hydropsychidae, Philopotamidae, Hydroptilidae and Leptoceridae were considered in detail. The drift of larvae peaked at night in both early and late larval instars. The drift of a larval group was more often related to the benthic density of other larval groups than to its own benthic density. Self-regulation of an upper benthic density of a larval group by emigration through drift was not statistically evident. There was no straightforward relationship between drift and abiotic factors. Drift rates differed between taxa as well as between larval instars with a taxon. Newly hatched larvae had very high drift rates, whereas the last larval instar usually had the lowest drift rate. Drift estimates, made at the same time as a monitoring program on possible side-effects of insecticides, failed to reflect benthic densities except in the night drift of Hydropsychidae. (Author's abstract)
W88-10658

COLDINGHAM LOCH, S.E. SCOTLAND: I. PHYSICAL AND CHEMICAL FEATURES WITH SPECIAL REFERENCE TO THE SEASONAL PATTERNS IN NUTRIENTS,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
A. E. Bailey-Watts, A. A. Lyle, A. Kirika, and E. J. Wise.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 405-418, June 1987. 5 fig, 3 tab, 54 ref.

Descriptors: *Scotland, *Limnology, *Lakes, *Coldingham Loch, *Nutrients, *Seasonal variation, Conductivity, Hydrolic budget, Chemical analysis, Cations, Silica, Nitrates, Phosphorous, Sediments, Physical properties, Stratification, Conductivity, Calcium, Magnesium.

Coldingham Loch belongs to Hakansson's convex shape category. It lies in a basin of Silurian Greywackes rock within 0.25 km of coastal sea cliffs. The theoretical hydraulic replacement time is 3.17 years. The loch stratifies intermittently in summer. Fluctuations in oxygen concentration generally correspond to spells of mixing and stratification; low values of 10% saturation occur at the bottom. The sum of concentrations of major cations is in accordance with measured conductivities ranging between 380 micro S per cm, and 420 micro S per cm (k sub 25). The ratios of Na+/Cl- (0.04) are similar to those in sea water, while values for Ca2+/Cl- (0.85-1.01) and Mg2+/Cl- (0.79-0.88) reflect the bedrock. Nitrate concentrations were lowest in the summer. Changes in phosphorous and factors controlling this contrast markedly with those of nitrate. Adsorption by the sediments is considered to be the major process accounting for autumnal losses of phosphorus. Silica showed a less regular seasonal pattern, but varied with a maximum of 2.25 mg SiO2 per liter in August. (See also W88-10660) (Author's abstract)
W88-10659

COLDINGHAM LOCH, S. E. SCOTLAND: II. PHYTOPLANKTON SUCCESSION AND ECOLOGY IN THE YEAR PRIOR TO MIXER INSTALLATION,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
A. E. Bailey-Watts.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 419-428, June 1987. 4 fig, 32 ref.

Descriptors: *Limnology, *Coldingham Loch, *Scotland, *Phytoplankton, *Ecology, *Biomass, *Eutrophic lakes, Chlorophyll a, Seasonal variation, Diatoms, Desmids, Blue-green algae, Silica, Nitrogen, Physical properties, Environment, Population density, Lakes, Limiting nutrients.

Total phytoplankton biomass in the small (8 ha) intermittently stratifying, eutrophic Coldingham Loch exhibited spring and automn maxima of about 35 micrograms chlorophyll a per liter. It is likely that nitrogen in summer and silica at various times of the year limited the growth of certain species; it is also possible that phosphorus limited growth in spring. When physical conditions and nutrient concentrations are resolved into their basic seasonal patterns, a number of species preferences for particular environmental requirements become apparent. The observed periodicity is examined in relation to recently published schemes that summarize phytoplankton-environment interactions. (See also W88-10659). (Author's abstract)
W88-10660

DOES IONIC STRENGTH AFFECT THE CONFIGURATION OF AQUATIC HUMIC SUBSTANCES, AS INDICATED BY GEL FILTRATION,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 7B.
W88-10661

OCCURRENCE OF PHOSPHORUS AND ITS POTENTIAL REMOBILIZATION IN THE LITTORAL SEDIMENTS OF A PRODUCTIVE ENGLISH LAKE,
Vermont Univ., Burlington. Dept. of Geology.
J. C. Drake, and S. I. Heaney.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 513-523, June 1987. 8 fig, 2 tab, 35 ref.

Descriptors: *Limnology, *Phosphorus, *Eutrophic lakes, *Sediments, Path of pollutants, Lakes, Littoral environment, Hydrogen ion concentration, Esthwaite Water, Sediment-water interfaces, Cores, Chemical analysis, Algae, Biomass, Hypolimnion, In situ tests, Nutrients, Phytoplankton, Cycling nutrients, Water pollution sources.

Vertical profiles of pH were measured at nine shallow water locations in Esthwaite Water. These indicate strong gradients of pH near the sediment-water interface suggesting a marked buffering capacity of the sediments. Thirteen littoral sediment cores were horizontally sectioned and sequentially extracted and analyzed for soluble reactive phosphorus. The rate of release of phosphorus from intact sediment cores was measured in the laboratory as a function of the pH of overlying water, yielding the relationship log K = 0.54pH-3.94, K-mg P per square meter per day. The maximum release rate measured was 75 mg P per square meter per day at pH10.5. Experiments on sediment slurries indicate that the release of phosphorus at pH 10 is rapid with approximately 50% of the total NaHCO3 + NaOH extractable phosphorus being released within 3 hr. Phosphorus release from the littoral sediments may equal or exceed external sources plus hypolimnetic inputs during periods of high pH associated with times of maximum algal biomass. (Author's abstract)
W88-10663

ORDINATION AND CLASSIFICATION OF MACROINVERTEBRATE ASSEMBLAGES IN THE CATCHMENT OF THE RIVER WYE IN RELATION TO ENVIRONMENTAL FACTORS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
S. J. Ormerod, and R. W. Edwards.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 533-546, June 1987. 6 fig, 8 tab, 48 ref.

Descriptors: *River Continium Concept, *Rivers, *Macroinvertebrates, *Correlation analysis, *River Wye, Slopes, Statistical analysis, Mollusks, Crustacea, Fauna, Wales, Stoneflies, Aquatic insects, Decorana, Twinspan, Hardness, Gradients.

Macroinvertebrates were sampled from three habitats at 45 sites in the catchment of the Welsh River Wye. Species assemblages were ordinated by DECORANA, classified by TWINSPAN and related to physico-chemical factors using correlation and multiple discriminant analysis, respectively. DECORANA axis 1 was correlated with pH or total hardness, while axis 2 correlated with slope or distance from the source. TWINSPAN groupings were also related to hardness and to a lesser extent, slope. Assemblages at soft water sites (less than 15 g per cubic meter CaCO3) were composed mostly of Plecoptera but at hard-water sites, even at high slope (greater than 10 m per km), the fauna was dominated numerically by Ephemeroptera, net-spinning Trichoptera, Mollusca and Crustacea. It is concluded that these data do not support the River Continuum Concept unless there are modifications to allow for multiple gradients. (Author's abstract)
W88-10664

RESPONSE OF ASTERIONELLA FORMOSA TO GERMANIUM: IMPLICATIONS FOR THE GERMANIUM-INHIBITION TECHNIQUE FOR ESTIMATING DIATOM CONTRIBUTION TO COMMUNITY PRODUCTIVITY,
Allegheny Coll., Meadville, PA. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W88-10665

RELATIVE IMPORTANCE OF ALGAE AND BACTERIA AS FOOD FOR DAPHNIA LONGISPINA (CLADOCERA) IN A POLYHUMIC LAKE,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
P. Kankaala.
Freshwater Biology FWBLAB, Vol. 19, No. 3, p 285-296, June 1988. 7 fig, 3 tab, 44 ref.

Descriptors: *Limnology, *Algae, *Bacteria, *Lakes, *Daphnia, *Polyhumic lakes, *Plankton, Food habits, Finland, Biomass, Phytoplankton, Ecosystems, Dissolved solids, Organic carbon, Zooplankton, Limnology, Oligotrophic lakes, Allochthonous organic matter, Flagettates.

Grazing on algae and bacteria by the planktonic cladoceran, Daphnia longispina, was studied in a small polyhumic lake with low phytoplankton primary production in southern Finland. D. longispina filtered algae at average rates of 0.09-0.82 ml per ind per h. The filtering rates on bacteria were 26-92% of those on algae in parallel experiments. From June to August algae, including mixotrophic and heterotrophic forms, comprised 56-93% of the food ingested by D. Longispina. In mid-September and early October, when the Daphnia population was declining and the algal biomass was low, bacteria comprised 73% and 55%, respectively, of the food of Daphnia. For D. longispina, an energy pathway via bacteria and bactivorous flagellates is probably a more important link to allochthonous organic matter than direct utilization of epilimnetic bacteria. (Author's abstract)
W88-10667

DECAY RATES OF AUTUMN AND SPRING LEAF LITTER IN A STREAM AND EFFECTS ON GROWTH OF A DETRITIVORE,
Division of Ecology (Aquatic Ecology Group), Department of Biological Sciences, University of Calgary, Calgary, Alberta, Canada.
A. Garden, and R. W. Davies.
Freshwater Biology FWBLAB, Vol. 19, No. 3, p 297-303, June 1988. 4 fig, 3 tab, 24 ref.

Descriptors: *Leaves, *Streams, *Aquatic insects, *Detritivores, *Litter, Ecosystems, Biomass, Decomposing organic matter, Decomposition, Chemical analysis, Seasonal variation, Ecology, Limnology, Macroinvertebrates, Popular trees.

Differences in decay rates of autumn and spring balsam poplar (Populus balsamifera L.) leaf litter

input to a stream and their effects on a lotic detritivore Tipula commiscibilis Diane were investigated. Autumnal leaf litter decay rates were significantly greater than spring decay rates despite higher initial quality of spring leaves. Reduced spring/summer decomposition rates were the result of decreased microbial activity and biomass, and significantly lower numbers, kinds and biomass of macroinvertebrate detritivores. Growth of T. commiscibilis was significantly lower when fed spring leaves indicating that they were a poorer quality food source than autumn leaves. Lower numbers of detritivores coupled with reduced leaf quality resulted in lower leaf litter decay rates characteristic of spring/summer. (Author's abstract)
W88-10668

INPUT, MOVEMENT AND EXCHANGE OF ORGANIC MATTER WITHIN A SUBTROPICAL COASTAL BLACKWATER RIVER-FLOODPLAIN SYSTEM,
Georgia Univ., Athens. Dept. of Entomology.
T. F. Cuffney.
Freshwater Biology FWBLAB, Vol. 19, No. 3, p 305-320, June 1988. 4 fig, 8 tab, 48 ref. NSF Grants DEB 8104427 and BSR 8406631.

Descriptors: *Organic matter, *Rivers, *Flood plains, *Cycling nutrients, *Subtropic zone, Georgia, Ogeechee River, Litter, Respiration, Model studies, Ecosystems, Detritus, Decomposition, Limnology, Decomposing organic matter.

Inputs, movements and exchanges of particulate organic matter were measured on two contrasting floodplains of the Ogeechee River, Georgia. A model, which incorporated measurements of standing crop, respiration, litterfall, inundation, and litter processing rates, was used to estimate annual exchanges of organic matter between the river and floodplains. Annual litterfall was higher on the east floodplain than on the lower elevation west floodplain. Experiments with tagged leaves and sticks demonstrated that litter was readily displaced during floods. The distance and direction of displacement varied within and between floodplains but tended to be higher closer to the river and was generally parallel to the river. The model indicated that both floodplains lost organic matter to the river. The lower elevation floodplain lost more organic matter to the river than did the higher elevation floodplain. Floodplain organic matter inputs may exert a greater influence upon structure and function within these streams than do upstream inputs or primary production. Consequently, current conceptualizations of stream structure and function need to be modified to account for the effects of floodplain inputs on stream channel processes within large, low-gradient rivers. (Author's abstract)
W88-10669

PHOSPHORUS TRANSFORMATIONS IN THE EPILIMNION OF HUMIC LAKES: ABIOTIC INTERACTIONS BETWEEN DISSOLVED HUMIC MATERIALS AND PHOSPHATE,
Loughborough Univ. of Technology (England). Dept. of Human Sciences.
R. I. Jones, K. Salonen, and H. De Haan.
Freshwater Biology FWBLAB, Vol. 19, No. 3, p 357-369, June 1988. 9 fig, 42 ref.

Descriptors: *Limnology, *Cycling nutrients, *Chemical sequestartion, *Phosphorus, *Epilimnion, *Lakes, *Phosphate, Chemical analysis, Humic acid, Phytoplankton, Biomass, Finland, Gel filtration, Organic matter, Iron, Orthophosphate, Limnology, Molecular weight, Light effects.

Sephadex gel filtration of filtered water from small, Finnish forest lakes demonstrated abiotic movement of P from added PO4 to two higher molecular weight fractions. This movement was most pronounced in waters with high humic content which also had high iron content. The two fractions which took up P had nominal molecular weights of greater than 100,00 and 10,000-20,000. Additions of ferric iron up to 1 mg Fe per liter to the filtered lake water stimulated movement from free PO4, and provided high concentrations of humic materials. In the absence of humic materials, even 0.1 mg Fe per liter would precipitate all added PO4. The high molecular weight P was only partially reactive with standard molybdate reagents. Exposure of the high molecular weight P to sunlight caused a small release of PO4 under the experimental conditions employed. Possible implications for biological phosphorus demand of such sequestration of free PO4 by humic materials in combination with iron are discussed. (Author's abstract)
W88-10670

DISSOLVED ORGANIC MATTER IN CUMBRIAN LAKES AND STREAMS,
Freshwater Biological Association, Ambleside (England).
E. Tipping, J. Hilton, and B. James.
Freshwater Biology FWBLAB, Vol. 19, No. 3, p 371-378, June 1988. 5 fig, 4 tab, 28 ref.

Descriptors: *Limnology, *Optical properties, *Dissolved solids, *Lakes, *Streams, *Cumbria, Seasonal variation, Phytoplankton, Regression analysis, Chemical analysis, Water sampling, Surface water, Ecology, Limnology.

A survey of dissolved organic carbon concentration (DOC) and optical absorbance at 340 nm (A sub 340) was carried out for thirteen lakes and twenty-three streams in Cumbria (England) over the period May 1986 to April 1987. Values of DOC were in the range 0-6.2 mg per liter, no water having a mean DOC greater than 3.6 mg per liter. Streamwaters showed no gross seasonal dependence in DOC, but there was a peak in DOC associated with the first major rain event of autumn 1986. Summer values of DOC in lakes were greater than winter values, probably because of the production of DOC by phytoplankton. In streams, DOC was weakly positively correlated with discharge, as estimated from rainfall. A sub 340 was more strongly correlated. Linear regression of mean A sub 340 against mean DOC for streams gave a slope consistent with the absorptivities of aquatic humic substances, and a positive intercept on the abscissa that suggests the presence of, on average, 0.6 mg per liter of DOC that does not absorb at 340 nm. Lake samples taken in winter gave a similar A sub 340/DOC relationship to that for streams, but in summer A sub 340/DOC ratios were lower, suggesting that phytoplankton-derived DOC absorbs weakly or not at all at 340 nm. (Author's abstract)
W88-10671

PHYTOPLANKTON OF AN ENRICHED, SOFT-WATER LAKE SUBJECT TO INTERMITTENT HYDRAULIC FLUSHING (GRASMERE, ENGLISH LAKE DISTRICT),
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 5C.
W88-10672

EPILITHIC BACTERIA IN AN ACID AND CALCAREOUS HEADSTREAM,
Hull Univ. (England). Dept. of Plant Biology.
R. Goulder.
Freshwater Biology FWBLAB, Vol. 19, No. 3, p 405-416, June 1988. 1 fig, 4 tab, 58 ref.

Descriptors: *Calcareous streams, *Aquatic bacteria, *Streams, *Acid streams, *Water quality, Environment, Seasonal variation, Hydrogen ion concentration, Chlorophyll a, Temperature, Regression analysis, Food chains, Water sampling, Burbage Brook, River Lathkill, Comparison studies, England.

Environmental variables and epilithic bacteria on small stones were monitored during summer and winter in Burbage Brook and the River Lathkill, two headstreams in the Derbyshire Peak District. Burbage Brook was usually near-neutral in summer, but acid in winter. The River Lathkill was circumneutral throughout the year. In summer, epilithic bacteria showed few between-stream differences. In winter, total bacteria, colony forming units, per cent chromogenic colony forming units, per cent viable bacteria, V sub max for glucose mineralization and V sub max/bacterium were all significantly less in the acid Burbage Brook. Inhibition of epilithic bacteria in Burbage Brook was also observed when pH fell to a low level during a summer spate. Multiple-regression analysis confirmed that epilithic bacteria were less successful at low pH but also suggested that pH was not the only environmental variable to influence epilithic bacteria. Especially notable were positive relationships with density of epilithic chlorophyll a and temperature in Burbage Brook and with chlorophyll a in the River Lathkill. (Author's abstract)
W88-10673

IN VITRO STUDIES ON SULFATE REDUCTION AND ACIDIFICATION IN SEDIMENTS OF SHALLOW SOFT WATER LAKES,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5B.
W88-10674

CYCLING AND RETENTION OF NITROGEN AND PHOSPHORUS IN WETLANDS: A THEORETICAL AND APPLIED PERSPECTIVE,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
C. Howard-Williams.
Freshwater Biology FWBLAB, Vol. 15, No. 4, p 391-431, August 1985. 16 fig, 8 tab, 205 ref.

Descriptors: *Cycling nutrients, *Nutrient removal, *Wastewater disposal, *Limnology, *Wetlands, *Nitrogen, *Phosphorous, Ecosystems, Ecology, Groundwater, Nutrients, Fauna, Literature review, Detritus, Sediments, Evapotranspiration, Vegetation, Hydrology, Floods, Microorganisms.

This review considers the internal fluxes and transformations of nitrogen and phosphorous in wetland ecosystems. Emphasis is placed on the dynamic nature of nutrient cycling and the review stresses the possible use of wetlands as sinks for unwanted nutrients. Successional time scales, exchange equilibria and the concepts of storage and throughflow, resource consumption and supply are explained. Descriptions of the basic pathways of nutrients through different types of wetland systems are given with the emphasis placed on the movement into and out of the major storage compartments of wetland systems. The problems of conversion of qualitative information on nutrient movements and transformations, into data on mass flows are then discussed. The review then considers the effects of adding nutrients to wetlands. The concept of the loading capacity is discussed in relation to the length of time a wetland can continue to remove nutrients from throughflow. Recent studies show that artificially created wetlands can be effective systems for nutrient removal only if their internal removal mechanisms are understood and if these are optimized by management techniques. (Author's abstract)
W88-10675

FORCES ON MICROORGANISMS AT SURFACES IN FLOWING WATER,
Southampton Univ. (England). Dept. of Biology.
For primary bibliographic entry see Field 2E.
W88-10676

DENITRIFICATION CAPACITY OF SEDIMENT FROM A HYPEREUTROPHIC LAKE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
H. F. Kaspar.
Freshwater Biology FWBLAB, Vol. 15, No. 4, p 449-453, August 1985. 3 fig, 25 ref.

Descriptors: *Lake sediments, *Eutrophic lakes, *Denitrification, *Sediments, *Lakes, Nitrates, Michigan, Anaerobic conditions, Wintergreen Lake, Acetylene, Nitrogen removal.

In sediment from Wintergreen Lake, Michigan, denitrification was not detectable by the acetylene inhibition methods at in situ nitrate concentrations. When nitrate was added to sediment slurries, denitrification capacities up to 18.8 micro g N per g per h were measured. The denitrification capacities decreased with increasing sediment depth and distance from shore. The high denitrification capacities in these sediments which under natural conditions had no supply of nitrate and oxygen suggested that denitrifiers with alternative mechanisms for anaerobic energy conversion were present. Nitrous oxide was a significant portion of the N-gas produced immediately after the nitrate addition. Small amounts (4-5% of the total N-gas production) of nitric oxide accumulated in the early phase of nitrate reduction. Presumably after depletion of nitrate and nitrite both N2O and NO were further reduced to N2. About 70% of the added nitrate was denitrified, and the remainder was assumed to have been reduced to ammonium. (Author's abstract)
W88-10677

ENVIRONMENTAL CUES FOR CYCLOMORPHOSIS IN DAPHNIA RETROCURVA FORBES,
Wisconsin Univ., Madison. Dept. of Zoology.
J. E. Havel, and S. I. Dodson.
Freshwater Biology FWBLAB, Vol. 15, No. 4, p 469-478, August 1985. 5 fig, 4 tab, 35 ref.

Descriptors: *Aquatic animals, *Crustaceans, *Daphnia, *Environmental effects, *Morphology, Plankton, Zooplankton, Temperature, Chaoborus, Leptodora, Hydra, Photoperiodism, Turbulent flow, Statistical methods, Limnology, Invertebrates, Utricularia.

The invertebrate predators, Chaoborus, Leptodora, Hydra, Utricularia, and cyclopoid copepods were ineffective as inducers of high helmets in laboratory reared Daphnia retrocurva. Lake water from different sources, when used as culture medium, was also ineffective. High helmets were induced when clones were grown under warm and turbulent conditions. Presence or absence of illumination and varying photoperiod did not affect helmet growth in warm trubulent cultures. Different clones grown under warm turbulent conditions differed in their responsiveness to the treatment, but no relationship between helmet size in clones and helmet size in the field on the dates of clone isolation was demonstrated. Laboratory-induced phenotypes were rarely as extreme as those of field animals. (Author's abstract)
W88-10679

ACCLIMATION OF STREAM-BED HETEROTROPHIC MICROFLORA: METABOLIC RESPONSES TO DISSOLVED ORGANIC MATTER,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
L. A. Kaplan, and T. L. Bott.
Freshwater Biology FWBLAB, Vol. 15, No. 4, p 479-492, August 1985. 7 fig, 3 tab, 31 ref. NSF Grant DEB-7921963.

Descriptors: *Stream biota, *Benthic flora, *Acclimatization, *Heterotrophic bacteria, *Metabolism, *Organic matter, Dissolved solids, Sediments, Streambeds, Biomass, Pennsylvania, West Creek, Saw Mill Spring, White Clay Creek.

Studies were performed to assess the acclimation of the stream-bed heterotrophic microflora to sources of dissolved organic matter (DOM) typical of its environment and microfloral responses to pulses of DOM. Microcosm measurements of dissolved organic carbon (DOC) uptake, dissolved oxygen uptake, ATP concentration and epifluorescence microscopic counts (EMC) were performed using stream-bed sediments and heterogeneous DOM. Three study sites included an undisturbed woodlot spring seep, a small stream traversing a cattle pasture and a larger stream draining a catchment used for silage crops, pastures and woodlands. The DOM sources were cold water extracts of forest floor leaf litter, bovine manure, the green alga Ulothrix and jewel weed leaves. A minimum of 48 h of cumulative exposure to bovine manure DOM at 15-20 degrees centigrade were required to yield measurable changes in sediment microbial activity of sediment microbial biomass. The time frame of microfloral responses during acclimation indicated that changes leading to the metabolism of a DOM source were initially enzymatic and eventually involved growth and selection for specific decomposers within the microbial community. It was concluded that in order to utilize naturally occurring pulses of carbon and energy, stream-bed heterotrophs must be already enzymatically prepared, and induced when the pulse occurs. (Author's abstract)
W88-10680

THERMAL AND CHEMICAL STRATIFICATION AND MIXING IN A SMALL TROPICAL RESERVOIR, SOLOMON DAM, AUSTRALIA,
James Cook Univ. of North Queensland, Townsville (Australia).
P. R. Hawkins.
Freshwater Biology FWBLAB, Vol. 15, No. 4, p 493-503, August 1985. 7 fig, 19 ref.

Descriptors: *Mixing, *Australia, *Solomon Dam, *Limnology, *Thermal stratification, *Chemical stratification, Epilimnion, Hypolimnion, Seiches, *Lakes, Temperature, Thermocline, Lake classification, Seasonal variation, Reservoirs, Dissolved oxygen, Iron, Tropical regions.

The patterns of distribution of temperature, dissolved oxygen, and filterable iron in the water mass of Solomon Dam were determined at about 30 day intervals over a 2.5 year period (1981-83). The thermal stratification, and resultant chemical differentiation of the epilimnion and hypolinmion, was the dominant limnological feature of the reservior. A pronounced thermocline was present for most of the year and, during the stratified phase, diurnal circulation appeared to be the main mechanism for mixis. Evidence for the presence of an internal seiche, a phenomenon commonly associated with stratified water bodies, was also observed. An annual overturn in June-July coincided with the minimum in solar radiation. The 'wet' season (January-March) caused either partial or complete circulation depending on the volume of the reservoir and the rate of inflow. In 1982 the lake circulated once, fitting the warm monomictic pattern, but in 1983 there were two circulations, the first resulting from flood inflows. The study illustrated the inappropriate nature of a thermally derived classification scheme for a small reservoir. (Author's abstract)
W88-10681

SPATIAL VARIATIONS IN AND CONTROLS ON THE CALCITE SATURATION INDEX IN ACTON LAKE, OHIO,
Miami Univ., Oxford, OH. School of Interdisciplinary Studies.
W. J. Green, D. E. Canfield, and B. A. Steinly.
Freshwater Biology FWBLAB, Vol. 15, No. 5, p 525-533, October 1985. 4 fig, 2 tab, 21 ref.

Descriptors: *Limnology, *Lakes, *Saturation index, *Calcite, Spatial distribution, *Geochemistry, Dissolved oxygen, Temperature, Conductivity, Water sampling, Hydrogen ion concentration, Dissolved organic matter, Calcium, Carbonates, Eutrophic lakes, Acton Lake, Ohio.

Over a period of 5 weeks in mid-summer 1979, water samples were collected from Acton Lake (in southwestern Ohio), and its streams and analyzed for seven major ionic species, temperature, dissolved O2, pH, and conductivity. Geochemically the waters are characterized by high calcium and bicarbonate concentrations. Data obtained on all samples were used to compute calcite saturation indices (SI) and to map the spatial distribution of this function throughout the system. The SI were corrected for activity and ion pairing effects and yet are still to our knowledge among the highest values reported for a natural water. The good correlations obtained between the SI and both the pH and dissolved oxygen clearly indicate that biological activity is the dominant control on the degree of saturation in this largely isothermal lake. To account for the extreme departure from chemical equilibrium, it is proposed that dissolved organic matter may be poisoning freshly formed calcite surfaces and preventing them from serving as effective nucleation centers. (Author's abstract)
W88-10682

LIFE HISTORY AND ECOLOGICAL ROLE OF THE XYLOPHAGOUS AQUATIC BEETLE, LARA AVARA, LECONTE (DRYOPOIDEA: ELMIDAE),
Oregon State Univ., Corvallis. Dept. of Entomology.
R. J. Steedman, and N. H. Anderson.
Freshwater Biology FWBLAB, Vol. 15, No. 5, p 535-546, October 1985. 2 fig, 8 tab, 24 ref. NSF Grant BSR-8022190.

Descriptors: *Stream biota, *Aquatic insects, *Water beetles, *Lara avara, *Streams, *Degradation, Elmidae, Xylophagous aquatic beetle, Wood wastes, Life history studies, Larvae, Oregon, Ecosystems, Life cycles, Dryopoidea.

This study documents the life history of the xylophagous elmid beetle, Lara avara, and estimates its contribution to wood degradation in Oregon streams. The life cycle was found to be 4 to 6 or more years long, with all but 2-3 months of that spent in the larval stage. Larvae grow through seven instars, taking about 1 year for instars 1-3, and from 3 to 5 or more years for instars 4-7. Last-instar larvae leave the water to pupate. Adults live approximately 3 weeks and occur from May to August. The eggs are deposited on submerged wood. Larvae probably obtain their nutrition by absorbing substances liberated into decaying wood by microbial activity. They do not produce their own cellulase, nor do they have a symbiotic gut flora similar to that of xylophagous cranefly (Tipulidae) larvae. Fecal production by Lara avara larvae averaged 13% dry body weight per d. This yields an estimate of fecal production of 1.6 g per square m per y in Oregon Coast Range streams (about 0.3% per y of wood standing crop). (Author's abstract)
W88-10683

PATTERNS OF MACROINVERTEBRATE COLONIZATION ON FRESH AND SENESCENT ALDER LEAVES IN TWO MICHIGAN STREAMS,
Michigan State Univ., East Lansing. Dept. of Entomology.
R. J. Stout, W. H. Taft, and R. W. Merritt.
Freshwater Biology FWBLAB, Vol. 15, No. 5, p 573-580, October 1985. 4 fig, 1 tab, 24 ref, append. Department of Navy Contract N00039-81-C-0357.

Descriptors: *Streams, *Macroinvertebrates, *Leaves, Michigan, Invertebrates, Biomass, Deciduous forests, Alder leaves, Alnus rugosa, Aquatic insects, Ecology.

Communities of invertebrates colonizing senescent autumn and fresh summer alder leaves (Alnus regosa) were compared. Leaf packs for each treatment were placed in two hardwater streams in the Upper Peninsula of Michigan in late summer and early autumn. One stream has a cobble-bottom and the other a sand-bottom and both receive fresh leaf inputs by beaver fellings. Fresh leaf packs remained intact after 26 days immersion, but thereafter were processed faster than were the autumn leaf packs in both streams. In the cobble-bottom stream taxon richness, numbers of individuals and biomass were higher on fresh than on autumn leaves. Fresh leaves in the sand-bottom stream supported a more diverse, richer, and equitably distributed insect fauna than did the autumn leaves. A discussion is presented on the simultaneous lack of fresh leaf loss and the presence of more complex insect communities on those leaves during the first 26 days of the study. Invertebrates in both mid-latitude heterotrophic streams and in tropical lowland wet forest streams may rely on fresh leaf inputs, which have received little attention. (Author's abstract)
W88-10684

FORMATION OF THERMAL STRATIFICATION IN A SMALL TEMPERATE LAKE,
Polish Academy of Sciences, Chybie. Fish Culture Experimental Station.
M. A. Szumiec.
Freshwater Biology FWBLAB, Vol. 15, No. 5, p 581-586, October 1985. 5 fig, 21 ref.

Descriptors: *Thermal stratification, *Limnology, *Lakes, *Temperate zone, Esthwaite Water, England, Kinetic energy, Wind, Spatial distribution, Isotherms, Thermocline.

The origin of vertical temperature stratification in Esthwaite Water (Lake District, Cumbria, England) was observed. At the first stage of the spring warming of the whole water column some discontinuity in the vertical temperature distribution appears in the surface and bottom layers. Persistent summer stratification occurred for the first time at the lee end of the lake immediately after a change of wind direction, when the cumulative potential energy deficit dominated the cumulative kinetic energy by about 1 x 10 to the (-8) power J per square cm. The results show the importance of the proper choice of initial conditions in computations of total energy, as well as the necessity to consider the spatial distribution of potential and mechanical energy responsible for the summer stratification in the lake. (Author's abstract)
W88-10685

EFFECTS OF VEGETATION REMOVAL BY GRASS CARP AND HERBICIDES ON THE WATER CHEMISTRY OF FOUR FLORIDA LAKES,
Rollins Coll., Winter Park, FL. Dept. of Biology.
For primary bibliographic entry see Field 4A.
W88-10686

DETERMINATION OF BIOLOGICALLY AVAILABLE PHOSPHORUS USING A RADIOBIOASSAY TECHNIQUE,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
For primary bibliographic entry see Field 7B.
W88-10687

FEEDING EFFICIENCIES OF CHIRONOMUS PLUMOSUS (L.) AND C. ANTHRACINUS ZETT. (DIPTERA: CHIRONOMIDAE) IN MESOTROPHIC LAKE ERKEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
R. K. Johnson.
Freshwater Biology FWBLAB, Vol. 15, No. 5, p 605-612, October 1985. 4 fig, 38 ref.

Descriptors: *Aquatic fauna, *Food habits, *Midges, *Aquatic insects, *Chironomus, *Limnology, *Mesotrophic lakes, Feeding rates, Phytoplankton, Diptera Lake Erken, Nitrogen, Carbon, Absorption, Flagellates, Sediments, Chemical analysis, Ecology, Ecosystems, Sweden.

Absorption efficiencies of nitrogen and carbon in two Chironomus species found dominating in the profundal zone of mesotrophic Lake Erken were determined gravimetrically. Absorption efficiencies for C. plumosus showed greater seasonal variation than those of C. anthracinus, with low efficiencies coinciding with the summer dominance of flagellate phytoplankton and with high C:N ratios. Overall means absorption efficiencies (plus or minus SE) for carbon and nitrogen, respectively, were 26.8% (plus or minus 1.9) and 29.3% (plus or minus 1.9) for C. plumosus, 24.6% (plus or minus 1.7) and 28.1% (plus or minus 1.8) for C. anthracinus. Significant differences were found to exist between the C:N ratios of the superficial 2 cm sediment layers and those of Chironomus anterior midgut contents. C. anthracinus appears to be a deposit feeder ingesting particulate matter scraped from the recently deposited surface sediments. The greater seasonal variation found in the absorption efficiencies of C. plumosus, together with the lower C:N ratios, support the contention that this species is a filter feeder with the nutritional quality of ingested matter depending primarily on pelagic inputs. (Author's abstract)
W88-10688

PHOSPHORUS INACTIVATION IN A EUTROPHIC LAKE BY THE DIRECT ADDITION OF FERRIC ALUMINIUM SULFATE: IMPACT ON IRON AND PHOSPHOROUS,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
For primary bibliographic entry see Field 5G.
W88-10689

LIMNOLOGICAL INVESTIGATIONS ON THE ROSETTA BRANCH OF THE NILE. I. ENVIRONMENTAL CONDITIONS,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, and M. H. Abbas.
Freshwater Biology FWBLAB, Vol. 15, No. 6, p 645-653, December 1985. 5 fig, 20 ref.

Descriptors: *Nile River, *Aquatic environment, *Rivers, *Deltas, *Limnology, Rosetta branch, Environment, Hydrogen ion concentration, Dissolved organic matter, Dissolved oxygen, Seasonal variation, Air temperature, Water temperature, Chemical analysis, Photosynthesis, Estuarine environment, Climatic data, Saline-freshwater interfaces.

Seasonal and local variations of some environmental conditions in the Rosetta branch of the River Nile are reported. The lowest air and water temperatures were recorded in January (winter) and the highest in July (summer). Slight decrease in water temperatures with depth is related to solar heating and mixing processes. The pH values, averaging between pH 7.5 and 8.2, showed seasonal changes which may be related to photosynthesis. The seasonal average chlorosity values showed very wide variation, due to fluctuations in the discharge rate of the River Nile and its effect on the estuarine sea water. Sharp increase in chlorosity values with depth at the esturaine stations was produced by the less dense river water, flowing over denser tongues of sea water. In January, however, the maximum discharge flushed out the sea water. Minimum oxygen saturation values occurred in January and the highest values of dissolved organic matter were obtained in July. Both of these will be shown in a later publication to be related to phytoplankton abundance. Increase in dissolved organic matter near the bottom was common and is interpreted as due to the more complete decomposition of descending dead organisms and the release of organic matter from the bottom deposits. (See W88-10691 thru W88-10692) (Author's abstract)
W88-10690

LIMNOLOGICAL INVESTIGATIONS ON THE ROSETTA BRANCH OF THE NILE: II. SEASONAL VARIATIONS OF NUTRIENTS,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, and M. H. Abbas.
Freshwater Biology FWBLAB, Vol. 15, No. 6, p 655-660, December 1985. 3 fig, 5 ref.

Descriptors: *Rivers, *Deltas, *Limnology, *Nile River, *Nutrients, Seasonal variations, Estuarine environment, Nitrates, Phosphates, Silicates, Phytoplankton, Ecology, Rosetta branch.

Samples were taken from 3 depths at 14 selected stations, treated with 0.5% chloroform and kept in stoppered polyethylene bottles. Dissolved inorganic nutrients in filtered samples and total phosphate in unfiltered samples were analysed spectrophotometrically. Determinations of nitrate, nitrite, reactive and total phosphate and silicate were carried out according to the methods described by the American Public Health Association. Nitrate tended to be low in the estuarine region compared with the freshwater stretches and seasonally was low in October. Nitrite broadly showed patterns similar to NO3 but at lower values. Reactive phosphate and silicate tended to be much higher in fresh compared with saline stretches and was high in January. These changes are broadly interpreted in relation to river discharge and the seasonality of phytoplankton although other, and as yet unstudied, causes will probably be found to be involved. (See also W88-10690 and W88-10692) (Author's abstract)
W88-10691

LIMNOLOGICAL INVESTIGATIONS ON THE ROSETTA BRANCH OF THE NILE: III. PHYTOPLANKTON,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, and M. H. Abbas.
Freshwater Biology FWBLAB, Vol. 15, No. 6, p 661-669, December 1985. 3 fig, 1 tab, 22 ref.

Descriptors: *Rivers, *Deltas, *Limnology, *Nile River, *Phytoplankton, *Algae, Surface waters, Estuarine environment, Diatoms, Chlorophta, Cyanophyta, Dinoflagellates, Rosette branch.

Seasonal qualitative and quantitative studies of the phytoplankton of the Rosetta branch of the River Nile are reported. Most of the genera were Bacillariophyceae, with Chlorophyceae and Cyanophyceae second and third. Only two genera of Dinophyceae were present. The phytoplankton can be broadly described as eurythermal and euryhaline. Phytoplankton tended to be more concentrated in surface waters and showed large variations from station to station, with noticeably lower values in the estuarine region except in January. Most of the genera were recorded at all times but seasonally the highest numbers of diatoms and green algae were found in July during a period of high temperature and low discharge whereas blue-greens achieved maximum density in October. (See W88-10690 thru W88-10691) (Author's abstract)
W88-10692

MACROINVERTEBRATE FAUNA OF AN ACID-STRESSED HEADWATER STREAM SYSTEM IN THE ADIRONDACK MOUNTAINS, NEW YORK,
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5C.
W88-10693

DISSOLVED OXYGEN BUDGET MODEL FOR LAKE ERIE IN SUMMER,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. C. Patterson, B. R. Allanson, and G. N. Ivey.
Freshwater Biology FWBLAB, Vol. 15, No. 6, p 683-694, December 1985. 6 fig, 20 ref. Environment Canada Contract OSE83-00039.

Descriptors: *Model studies, *Dissolved oxygen, *Lake Erie, *Water temperature, *Limnology, *Thermal stratification, Simulation analysis, Sediments, Thermocline, Wind.

A vertical mixng model of Lake Erie was extended with an oxygen budget model. The model was tested against data gathered in the summers of 1979 and 1980 with good results, showing that it is capable of simulating vertical distributions of temperature and dissolved oxygen over relatively short time periods. The results underline the importance of turbulent mixing in distributing oxygen throughout the water column in the central basin of the lake. In addition, the results indiciate that production and respiration processes dominate the budget under the influence of low wind speeds, while surface fluxes dominate during periods of high wind speed. Bottom mixing delays the onset of anoxic conditions at the sediment/water interface by distributing the sediment demand over the 5-6 m depth of the bottom mixed layer. (Author's abstract)
W88-10694

CORRELATES OF HABITAT FAVOURABILITY FOR BENTHIC MACROINVERTEBRATES AT FIVE STREAM SITES IN AN APPALACHIAN MOUNTAIN DRAINAGE BASIN, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
C. Miller.
Freshwater Biology FWBLAB, Vol. 15, No. 6, p

709-733, December 1985. 8 fig, 9 tab, 74 ref, append.

Descriptors: *Stream biota, *Aquatic habitats, *Benthic fauna, *Population dyanmics, *Survival, *Biomass, *Streams, Catchment areas, Habitats, Ecology, Appalachian Mountains, Cambarus, Leptoxis, Crayfish, Snails, Aquatic insects, Substrates, Macroinvertebrates.

Based on monthly samples taken over a 1-year period, average density, average standing biomass, and annual production of benthic macroinvertebrates were estimated at 5 sites within an Appalachian Mountain drainage basin. Two sites were on first order streams and differed from the three second order sites: they were smaller and more shallow and they were depressed in pH and chemical richness. Patterns of abundance of individual taxa, of higher taxonomic groups and of functional (feeding) groups differed according to whether abundance was measured as density, as standing biomass or as annual production. Standing biomass was chosen as the measure of macroinvertebrate abundance because available evidence indicates that only standing biomass is consistently correlated with survivorship, and thus with habitat favorability. Two non-insect taxa (the crayfish Cambarus and the snail Leptoxis carinata) dominated standing biomass at each site. Hypotheses based on differences in food resource and on competition appeared to be inconsistent with observed patterns of macroinvertebrate abundance. (Author's abstract)
W88-10695

FINE-LAYER DEPTH RELATIONSHIPS OF LAKEWATER CHEMISTRY, PLANKTONIC ALGAE AND PHOTOSYNTHETIC BACTERIA IN MEROMICTIC LAKE FIDLER, TASMANIA,
New Hampshire Univ., Durham. Dept. of Botany and Plant Pathology.
A. L. Baker, K. K. Baker, and P. A. Tyler.
Freshwater Biology FWBLAB, Vol. 15, No. 6, p 735-747, December 1985. 6 fig, 1 tab, 35 ref.

Descriptors: *Phytoplankton, *Photosynthetic bacteria, *Limnology, *Lakes, *Meromictic lakes, *Algae, Lake Fidler, Tasmania, Chemical analysis, Surface water, Mixolimnion, Cryptophyceae, Photosynthesis, Chlorophyta, Chrysophta, Diatoms.

Use of a multi-column thin-layer pneumatic sampler and modified analytic procedures has enabled resolutions of chemical and biological strata at 2.5 or 5.0 cm depth intervals. Examination of meromictic Lake Fidler, Tasmania, indicates the presence of a thin, intense stratum of bacteriochlorophyll d in the upper monimolimnion, associated with a discrete stratum of Chlorobium cf. limicola at the microaerobic interface between the oxygenated and sulphide-rich zones. Algae included small populations of Chlorophyceae, Chrysophyceae, Bacillariophyceae and Cryptophyceae. The chemical profile of Lake Fidler was stable, with a chemocline constant in position relative to the lake bottom. Marked heterogeneity of dissolved substances at depths in the vicinity of bacteria suggested endogenous influence of pH and gelbstoff ('gilvin' in Australia). Downwelling light attenuation was influenced primarily by gelbstoff in the mixilimnion, with only red light measurable below 2 m. Light was absorbed mainly by Chlorobium in the monomolimnion, and was unmeasurable deeper than 3 m. The absorption spectrum of the bacteriochlorophyll d in vivo, with a maximum absorbance at 721 nm, corresponds with the available downwelling light penetrating the mixolimnion to the Chlorobium layer. (Author's abstract)
W88-10696

EFFECTS OF OVERHEAD CANOPY ON MACROINVERTEBRATE PRODUCTION IN A UTAH STREAM,
Lake Superior State Coll., Sault Ste. Marie, MI. Dept. of Biology and Chemistry.
D. J. Behmer, and C. P. Hawkins.
Freshwater Biology FWBLAB, Vol. 16, No. 3, p 287-300, June 1986. 1 fig, 4 tab, 42 ref.

Descriptors: *Mountain streams, *Aquatic habitats, *Shade effects, *Secondary productivity, *Macroinvertebrates, Midges, Aquatic insects, Biomass, Seasonal variation, Utah, Comparison studies, Algae, Detritus, Phototaxis, Light effects, Wasatch Mountains, Streams, Sampling.

Macroinvertebrate abundance and production were compared between an open and shaded site of a stream in the Wasatch Mountains, Utah. Mean biomass was significantly higher at the open site for midges (Chironomidae), 4.6x, Baetis bicaudatus, 5.7x, B. tricaudatus, 2.3x, Drunella coloradensis, 12x, and Cinygmula sp., 1.6x. Abundance of most other macroinvertebrates (except black flies: Simuliidae) also was greater at the open site, but differences were not significant. Black fly biomass was 1.7x greater at the shaded site. Seasonal production, estimated by the size-frequency and instantaneous growth rate methods, was greater at the open site than the shaded site for most taxa (except black flies) and reflected differences in standing crops between the sites rather than differences in rate of growth. Excluding black flies, production at the open site was twice as high as at the shaded site. The greater abundance and production of most invertebrate taxa at the open site probably is associated with either higher quality food (algae and algal detritus), or a phototactic attraction to sunlit areas. Sampling of large cobbles was an efficient method for sampling all taxa except Cinygmula sp., which was more abundant on smaller substrate particles. (Author's abstract)
W88-10697

QUANTITATIVE OBSERVATIONS ON THE ABILITY OF EPIPHYTIC BACTERIA TO CONTRIBUTE TO THE POPULATIONS OF SUSPENDED BACTERIA IN TWO DISSIMILAR HEADSTREAMS,
Hull Univ. (England). Dept. of Plant Biology.
C. A. Rimes, and R. Goulder.
Freshwater Biology FWBLAB, Vol. 16, No. 3, p 301-311, June 1986. 3 fig, 5 tab, 28 ref.

Descriptors: *Epiphytes, *Aquatic bacteria, *Headwaters, *Mineralization, *Aquatic plants, *Population dynamics, Aquatic habitats, Acidic water, Streams, Comparison studies, England, Calcareous water, Aquatic drift.

Concentration of suspended bacteria in a calcareous headstream increased linearly from the source to 48 m; this indicated a diffuse origin of bacteria. Drift loss of suspended bacteria and glucose-mineralization capacity from this length of stream were measured, and estimates were also made of the total number and glucose-mineralization capacity of epiphytic bacteria associated with the luxuriant submerged aquatic vegetation. Mean drift loss per day represented 11-12% of total epiphytic bacteria and 8-18% of epiphyte glucose-mineralization capacity, hence the epiphytic population should be well able to sustain the observed downstream losses. In a 90 m length of a contrasting acid, granitic, headstream, in which submerged vegetation was principally a leafy liverwort, there was no downstream change in concentration of suspended bacteria. A substantial population of epiphytic bacteria was found in the acid stream, sufficient for only a 1-2% daily release to produce a doubling in concentration of suspended bacteria; reasons are suggested for the apparent non-release of epiphytes. (Author's abstract)
W88-10698

SPECTRAL DISTRIBUTION AND ATTENUATION OF UNDERWATER IRRADIANCE IN TASMANIAN INLAND WATERS,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
L. C. Bowling, M. S. Steane, and P. A. Tyler.
Freshwater Biology FWBLAB, Vol. 16, No. 3, p 313-335, June 1986. 10 fig, 3 tab, 59 ref.

Descriptors: *Tasmania, *Light penetration, *Limnology, *Turbidity, *Oligotrophic lakes, Photosynthesis, Phytoplankton, Seasonal variation, Aquatic habitats, Optical properties, Statistical methods, Prediction, Lakes, Natural water, Photosynthetically available radiation, Australia, Dystrophic lakes, Prediction, Secchi disks, Classification.

Measurements were made of the attenuation and spectral distribution of downwelling and upwelling photosynthetically-available radiation (PAR) in all the principal types of natural waters found in Tasmania. Few Tasmanian lakes are turbid but in those that are the underwater light climate is almost identical to that of non-turbid, humic lakes. Reflectance, R, varied with depth but not in the asymptotic way previously encountered. A linear relationship existed between the scattering coefficient, b, and nephelometric turbidity, but not at the approximate 1:1 ratio reported elsewhere. Most Tasmanian lakes are oligotrophic or dystrophic and phytoplankton rarely influenced the underwater light field. Seasonal variation in optical character is not great in natural lakes and their optical properties and light fields can be used typologically. Simple and multiple regression analysis showed that Secchi depth was a poor predictor of euphotic depth but the optical properties and the underwater light field of inaccessible lakes could be reasonably predicted from laboratory measurements made on small water samples, using regressions developed for a wide range of lakes with comparable optical properties. An optical classification of Tasmanian lakes made by cluster analysis agreed reasonably well with one based on edaphic, vegetational and chemical criteria. (Author's abstract)
W88-10699

CONTRIBUTION OF FUNGAL BIOMASS TO THE DIET OF A FRESHWATER ISOPOD (LIRCEUS SP.),
Georgia Univ., Athens. Inst. of Ecology.
S. Findlay, J. L. Meyer, and P. J. Smith.
Freshwater Biology FWBLAB, Vol. 16, No. 3, p 377-385, June 1986. 2 fig, 2 tab, 41 ref. NSF Grants BSR-8306440 and DEB 8104427.

Descriptors: *Isopods, *Aquatic fungi, *Limnology, *Secondary productivity, *Food chains, Aquatic plants, Radioactive tracers, Lakes, Isotope studies, Limiting nutrients, Organic carbon, Biomass.

The direct contribution of fungal biomass to the carbon needs of a freshwater isopod (Lirceus sp.) was measured using 14C-labelled fungi on leaf discs periodically throughout the growth of the fungus. Amount of label incorporated into fungal biomass, radioactivity appearing in Lirceus after feeding on labelled fungus and the standing stock of fungus were used to calculate incorporation of fungal C by the consumer. Incorporation rates ranged from 0.06 to 70 ng fungal C/mg wet wt isopod/h. These rates of incorporation represent from 0.05 to 57% of C respired by the isopod. Fungal C does not meet the carbon needs of this consumer and the role of fungi as modifiers of the leaf substrate may be more significant than their role as a food source. (Author's abstract)
W88-10700

ZOOPLANKTON ABUNDANCE, COMMUNITY STRUCTURE AND DYNAMICS IN RELATION TO INORGANIC TURBIDITY, AND THEIR IMPLICATIONS FOR A POTENTIAL FISHERY IN SUBTROPICAL LAKE LE ROUX, SOUTH AFRICA,
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
R. C. Hart.
Freshwater Biology FWBLAB, Vol. 16, No. 3, p 351-371, June 1986. 9 fig, 7 tab, 67 ref.

Descriptors: *Reservoir fisheries, *Lake le Roux, *South Africa, *Zooplankton, *Population dynamics, *Turbidity, *Daphnia, Limiting nutrients, Biomass, Temperature effects, Reproduction, Aquatic habitats, Seasonal variation, Light quality, Food habits, Food chains, Lakes, Species composition, Crustaceans, Predation, Annual variation, Reservoirs.

The abundance and composition of entomostracan zooplankton were studied between 1977 and 1984 in relation to abiotic and biotic conditions in Lake le Roux (LLR), a large silt-laden reservoir on the Orange River formed in 1976. Zooplankton biomass varied seasonally from winter lows below 50

mg/sq m dry wt at temperatures of 9-10 C to summer peaks generally above 1000 mg/sq m at 21-23 C. It correlated strongly and positively with prevailing water temperature and transparency but only weakly with chlorophyll concentration. Mean annual zooplankton biomass, which varied fourfold in 7 years, increased with annual mean transparency and especially with summer heat content which was itself positively correlated with transparency. Daphnid species showed most annual variation in abundance. Large forms were scarce or absent in two years of very low transparency and low planktivore abundance. The smaller D. longispina developed once during clearer conditions when more fish were present. Copepod biomass also varied inversely with turbidity, but was not as severely reduced at high turbidities. Smallmouth yellowfish is the principal planktivore and candidate fishery species in LLR. It feeds selectively on Lovenula and large daphnids. Catches and growth rates of yellowfish varied directly with the abundance of zooplankton, particularly large food forms, and with water transparency. High turbidity and associated food limitation seems to reduce standing stocks especially of the daphnid zooplankton more than the effects of fish predation. Spawning of yellowfish depends upon the release of water from an upstream reservoir which concurrently reduces transparency and thus zooplankton availability in LLR. Transparency values above 30-35 cm SD appear necessary for the development of sufficient and suitable zooplankton to benefit the fishery. (Author's abstract)
W88-10701

ADVECTIVE EFFECTS OF A RESERVOIR FLOOD ON ZOOPLANKTON ABUNDANCE AND DISPERSION,
Oklahoma Univ., Kingston. Biological Station.
J. M. Dirnberger, and S. T. Threlkeld.
Freshwater Biology FWBLAB, Vol. 16, No. 3, p 387-396, June 1986. 5 fig, 3 tab, 35 ref. NSF Grant DEB8022163.

Descriptors: *Reservoirs, *Flooding, *Lake Texoma, *Limnology, *Zooplankton, *Population dynamics, Biomass, Spatial distribution, Turbidity, Model studies, Aquatic habitats, Mathematical studies, Red River, Lakes, Plumes, Conductivity, Wind, Okalhoma, Texas, Vertical distribution.

The diel vertical distribution and abundance of zooplankton in the Red River arm of Lake Texoma, Oklahoma-Texas, were examined between 25 January and 26 June 1982. During periods of low river inflow, zooplankton vertical patchiness was related to wind stress. Zooplankton did not maintain distinct vertical patches under strong mixing. In mid May heavy rainfall in the reduced water retention time in the reservoir. The Red River water mass entered the lake as a turbid, surface overflow plume. During this period of flooding most zooplankton populations declined and the distributions of remaining individuals deepened. Greatest population losses occurred between 0 and 7 m, depths where most zooplankton had been concentrated prior to the flood. A model of population dynamics based on depth specific rates of water exchange between the lake and the Red River, estimated from conductivity changes through time, accounted for the general pattern of change in zooplankton abundance and vertical dispersion. (Author's abstract)
W88-10702

ROLE OF FISH IN THE REGULATION OF NUTRIENT CYCLING IN LAKE BALATON, HUNGARY,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
I. Tatrai, and V. Istvanovics.
Freshwater Biology FWBLAB, Vol. 16, No. 3, p 417-424, June 1986. 7 fig, 18 ref.

Descriptors: *Lake Balaton, *Eutrophic lakes, *Fish, *Limnology, *Hungary, Phytoplankton, Eutrophication, Primary productivity, Water quality control, Lakes, Hungary, Enclosure studies, Bream, Cycling nutrients.

In 1984 an enclosure experiment was carried out in order to elucidate the importance of nutrient supply from fish to phytoplankton during the critical summer period in eutrophic Lake Balaton. One enclosure was stocked with fish and the other left empty. Two peaks were recorded in primary production reaching maximum values in the fish enclosure. In the enclosure with fish, inorganic nitrogen concentrations increased gradually until the end of the experiment, with ammonia making up the largest component. Lower dissolved phosphorus concentrations in the fish enclosure, with its higher primary production rate, may indicate an intense cycling of this nutrient. The biological and chemical changes occurring in the enclosure suggest that bream removal can be an effective tool in water quality control for Lake Balaton. (Author's abstract)
W88-10703

MOVEMENTS OF SELF-MARKED CADDISFLY LARVAE, CHYRANDA CENTRALIS (TRICHOPTERA: LIMNEPHILIDAE), IN A SIERRAN SPRING STREAM, CALIFORNIA, U.S.A.,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
N. A. Erman.
Freshwater Biology FWBLAB, Vol. 16, No. 4, p 455-464, August 1986. 2 fig, 2 tab, 21 ref. University of California Water Resources Center Project UCAL-WRC-W-645.

Descriptors: *Spring streams, *Larvae, *Migration, *Caddisflies, *Aquatic habitats, *Reproduction, Spatial distribution, Seasonal variation, Cycling nutrients, Temperature effects, Limiting nutrients, Streams, California.

The tendency of larvae of Chyranda to mark themselves by adding colored plastic segments to their cases was used to study instream movements of the species. Plastic strips of different colors were placed at measured distances down a small spring stream and larvae cut pieces and incorporated them in their cases. Over 50% of the population moved upstream into cooler water prior to pupation in an exceptionally dry year. The greatest distance moved upstream by a single larva was 56.9 m. In a wet year, when daytime stream temperatures were cooler, 11-28% of the marked population moved upstream. Downstream movement occurred in both years late in the fifth instar. Larvae selected yellow in preference to other colors in laboratory tests and they preferred heavy, textured plastic to light, smooth plastic as they neared pupation. Upstream movements, found also in Desmona bethula in the same spring stream, may be an adaptation for avoiding pupation in areas of high temperature, low oxygen concentration, or intermittent flow. (Author's abstract)
W88-10704

ZOOPLANKTON ASSOCIATIONS IN SOME ETHIOPIAN CRATER LAKES,
Queen Mary Coll., London (England). School of Biological Sciences.
J. Green.
Freshwater Biology FWBLAB, Vol. 16, No. 4, p 495-499, August 1986. 1 fig, 3 tab, 29 ref.

Descriptors: *Oxygen depletion, *Crater lakes, *Zooplankton, *Limnology, *Alkalinity, Aquatic habitats, Crustaceans, Diurnal cycles, Water chemistry, Lakes, Ethiopia.

The zooplankton associations in five crater lakes in Ethiopia were examined in April 1984. The two least alkaline lakes had the most diverse zooplankton. The large diaptomid copepod Lovenula africana was present in the lakes with alkalinities between 10 and 63 milli-equiv/L, but was absent from Lake Chitu (239 milli-equiv/L). The contribution of the zooplankton to the nocturnal deoxygenation of Lake Aranguadi is negligible. (Author's abstract)
W88-10705

DISTRIBUTION OF BREEDING DIPPERS (CINCLUS (L.); AVES) IN RELATION TO STREAM ACIDITY IN UPLAND WALES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5C.
W88-10706

FLORA, FAUNA AND WATER CHEMISTRY OF TAGIMAUCIA CRATER, A TROPICAL HIGHLAND LAKE AND SWAMP IN FIJI,
Australian National Univ., Canberra. Dept. of Geography.
W. Southern, J. Ash, J. Brodie, and P. Ryan.
Freshwater Biology FWBLAB, Vol. 16, No. 4, p 509-520, August 1986. 4 fig, 2 tab, 29 ref.

Descriptors: *Fiji, *Tropic zone, *Tagimaucia Crater, *Water chemistry, *Limnology, *Aquatic habitats, Acidic water, Phytoplankton, Aquatic plants, Algae, Chlorophyll a, Primary productivity, Toads, Water birds, Nitrogen Phosphorus, Lakes, Aquatic animals, Cycling nutrients.

Tagimaucia crater lake and swamp are located at an altitude of 820m in Taveuni, Fiji. Rainfall exceeds evaporation in all seasons and residence time for water in the shallow lake (2.5-5.5 m deep) is only 4 days. Dissolved ion concentrations are low, and the water is slightly acidic. Median total phosphorus and total nitrogen are moderately high and probably represent dissolved and suspended organic matter. Median chlorophyll a concentrations were low and indicate low phytoplankton productivity. The swamp vegetation is dominated by Lepironia articulata (Retz.) Domin and algae which form floating sedge peat islands, and Pandanus taveuniensis St John and other small trees where alluvium and colluvium are infilling the margins of the crater. The surrounding slopes are forested. The fauna of the lake and swamp are low in both diversity and abundance. The only aquatic vertebrates observed were Anguilla eels and cane toads, Bufo marinus L., and the only bird was the swamp harrier, Circus approximans approximans Peale. A variety of aquatic insects were observed but crustaceans and other invertebrate taxa were scarcely recorded. Although the swamp and lake are otherwise undisturbed, several recently introduced plants and animals have been recorded. (Author's abstract)
W88-10707

VARIATIONS IN CARBON FRACTIONS WITHIN A DIMICTIC AND A MEROMICTIC BASIN OF THE JUNIUS PONDS, NEW YORK,
State Univ. of New York at Buffalo. Dept. of Biological Sciences.
M. P. Pendl, and K. M. Stewart.
Freshwater Biology FWBLAB, Vol. 16, No. 4, p 539-555, August 1986. 10 fig, 62 ref.

Descriptors: *Junius Ponds, *Organic carbon, *Limnology, *Aquatic habitats, *Cycling nutrients, Lakes, New York, Seasonal variation, Water temperature, Monimolimnion, Dimictic lakes, Meromictic lakes, Carbon cycle, Ice cover.

The Junius Ponds, a unique series of proximate glacial kettle basins located between the cities of Rochester and Syracuse, New York, contain basins of dimictic and meromictic nature. This study focused upon differences in partitioning of total inorganic carbon (TIC), particulate organic carbon (POC), and dissolved organic carbon (DOC) within the dimictic Junius Pond 7 (JP7) and the meromictic Junius Pond 5 (JP5). For TIC, variations with depth were much greater in JP5 than in JP7. However, seasonal variations were greater in JP7 than in JP5. These variations are attributed to differences in the mictic nature of the basins. Concentrations of POC were substantially less in the relatively clear mixolimnion of JP5 than in the epilimnion of JP7. Distinct POC layers formed at the oxic-anoxic boundary in both basins during late summer. The lower monolimnion of JP5 is believed to have the warmest water occurring under ice of any natural body of water in the continental United States east of the Mississippi River. The monimolimnetic region of JP5 has unusually low DOC:POC ratios of < or = 1:1. (Author's abstract)
W88-10708

SPECTRAL ABSORPTION AND SCATTERING PROPERTIES OF DISSOLVED AND PARTICULATE COMPONENTS IN RELATION TO THE UNDERWATER LIGHT FIELD OF SOME TROPICAL AUSTRALIAN FRESHWATERS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
J. T. O. Kirk, and P. A. Tyler.
Freshwater Biology FWBLAB, Vol. 16, No. 5, p 573-583, October 1986. 2 fig, 3 tab, 15 ref.

Descriptors: *Dissolved organic mater, *Light attenuation, *Australia, *Alligator Rivers, *Light quality, *Particulate matter, Turbidity, Optical properties, Humic acids, Aquatic habitats, Scattering, Absorption, Billabongs, Photosynthetically available radiation, Lakes.

The inherent optical properties (scattering coefficients and absorption coefficients across the photosynthetic waveband) are presented from diverse tropical water bodies (billabongs) in the Alligator Rivers Region of northern Australia. The data are used to interpret observed characteristics of the underwater light field as exemplified by the spectral distribution, and overall rate of attenuation, of photosynthetically available radiation (PAR). Attenuation of PAR, especially in the blue waveband, is caused primarily by intense light absorption by the yellow-brown humic pigments, both soluble and particulate, in the water. It was estimated that in six moderately turbid billabongs, light scattering increased attenuation by an average of 58% above that attributable to absorption alone, whereas in a highly turbid billabong the increase was 111%. A distinguishing feature of the optical character of these billabongs, compared with previously studied water bodies in southern Australia, is the great contribution to light absorption made by the particulate humic material. (Author's abstract)
W88-10709

SPATIAL VARIATION OF WATER TEMPERATURE CHARACTERISTICS AND BEHAVIOUR IN A DEVON RIVER SYSTEM,
Exeter Univ. (England). Dept. of Geography.
B. W. Webb, and D. E. Walling.
Freshwater Biology FWBLAB, Vol. 16, No. 5, p 585-608, October 1986. 11 fig, 4 tab, 36 ref.

Descriptors: *Reservoir releases, *Exe Basin, *Spatial distribution, *Water temperature, *Aquatic habitats, Seasonal variation, Catchment areas, England, Statistical methods, Mathematical studies, Trout, Growth, Fish, Rivers, Temperature effects, Fish establishment, Shading.

The results of 5 years of continuous monitoring of river water temperatures at seventeen stations within the Exe basin, Devon, England, are presented and discussed. Systematic spatial variation in mean annual water temperature was evident and was strongly related to the topographic variable of elevation. Deviations from this relationship reflect local influences of vegetation shading, runoff source and channel character. Considerable spatial variation in temperature extremes was also apparent, and the Exe basin differs from several other British river systems in exhibiting highest peak temperatures at downstream sites on the mainstream. Discharge from Wimbleball Reservoir exerted a significant influence on annual maxima and minima. A clear seasonal cycle characterized all stations and was objectively defined by second-order harmonic functions which varied in amplitude and phase across the study area. Marked spatial variability in the magnitude and timing of diurnal temperature fluctuations, in temperature duration curves and in accumulated temperatures was also recorded. The implications of the spatial variation in thermal regime for the growth of brown trout was also investigated. (Author's abstract)
W88-10710

EFFECTS OF TEMPERATURE AND PHOTOPERIOD ON LIFE HISTORY PARAMETERS OF DAPHNIA MAGNA (CRUSTACEA: CLADOCERA),
Helsinki Univ. (Finland). Dept. of Genetics.
H. Korpelainen.
Freshwater Biology FWBLAB, Vol. 16, No. 5, p 615-620, October 1986. 4 tab, 29 ref.

Descriptors: *Life history, *Temperature effects, *Photoperiodism, *Daphnia, *Population dynamics, Aquatic animals, Reproduction, Seasonal variation, Survival.

The life history responses of two common and three rare Daphnia magna clones to constant conditions of temperature and photoperiod were investigated, and intraspecific variation in the genes controlling growth, survivorship and on all reproductive parameters measured (generation time, intrinsic rate of increase and male production), while photoperiod influenced significantly only survivorship and male production. The maximum proportion of male offspring was produced at a low temperature and at a mid-range photoperiod. The likely mechanism whereby clones with different life histories are maintained in the population is discussed. (Author's abstract)
W88-10711

SPATIAL AND TEMPORAL VARIATION IN THE MACROINVERTEBRATE FAUNA OF STREAMS OF THE NORTHERN JARRAH FOREST, WESTERN AUSTRALIA: FUNCTIONAL ORGANIZATION,
Western Australia Univ., Nedlands. Dept. of Zoology.
S. E. Bunn.
Freshwater Biology FWBLAB, Vol. 16, No. 5, p 621-632, October 1986. 1 fig, 8 tab, 34 ref.

Descriptors: *River continuum concept, *Ecological models, *Macroinvertebrates, *Ecosystems, *Food habits, Spatial variation, Temporal variation, Jarrah Forest, Forests, Australia, Model studies, Aquatic insects, Organic matter, Riffles, Predation, Species diversity, Particlate matter, Streams.

Spatial and temporal changes in functional organization of the invertebrate community in streams of the northern jarrah forest, Western Australia, were examined in relation to the predictions of the river continuum concept of Vannote and others. The composition of the fauna was largely as predicted for forested headwater streams with detritivores, principally collectors, dominating the fauna. Although shredders are generally considered to be codominant in such streams, they were not abundant in the riffle areas sampled in this study. Some of the observed temporal changes in the composition of functional feeding groups agreed with those predicted by the generalized model. The abundance and richness of collectors were higher during the summer than winter, whereas the converse was true for filterers. This corresponded to the presumed availability of deposit and suspended fine-particulate organic matter during summer and winter, respectively. Scrapers and predators showed no consistent temporal pattern among sites. However, the density of predators was highly correlated with the density of other invertebrates, particularly collectors. Temporal changes in the abundance and richness of shredders were not synchronized with the marked summer input of coarse-particulate organic matter. The possible reasons for this, and the role of shredders in Australian stream ecosystems, are discussed. (Author's abstract)
W88-10712

SUSPENDED BACTERIA IN CALCAREOUS AND ACID HEADSTREAMS: ABUNDANCE, HETEROTROPHIC ACTIVITY AND DOWNSTREAM CHANGE,
Hull Univ. (England). Dept. of Plant Biology.
C. A. Rimes, and R. Goulder.
Freshwater Biology FWBLAB, Vol. 16, No. 5, p 633-651, October 1986. 10 fig, 6 tab, 38 ref.

Descriptors: *Acid rain effects, *Aquatic bacteria, *Hydrogen ion concentration, *Headwaters, *Streams, Assimilative capacity, Oligotrophic streams, Eutrophic streams, Calcareous streams, Acid stream, Comparison studies, Glucose assimilation, Isotopic tracers, Tritium, Turnover rate, England, Mineralization, Trophic level, Heterotrophic bacteria.

Concentration of total suspended bacteria and heterotrophic activity (as turnover rate and turnover rate/bacterium for glucose assimilation by a tritiated-glucose addition approach) were determined at distance intervals along four high-trophic-level calcareous headwater streams in the Yorkshire Wolds (England) and along four low-trophic-level acidic headwater streams in the Galloway Hills. Mean concentration of suspended bacteria was marginally greater in the calcareous streams, whereas turnover rate and turnover rate/bacterium were substantially greater. Further determinations of heterotrophic activity (as turnover rate, turnover rate/bacterium, the glucose mineralization capacity at saturation glucose concentration (= Vmax), and Vmax/bacterium for glucose mineralization by a kinetic approach) supported the conclusion that heterotrophic activity was greater in the calcareous streams. Mean cell volume of suspended bacteria, measured by electron microscopy, was greater in the calcareous streams. In the calcareous streams the concentration of total bacteria and turnover rate usually increased substantially, in a straight-line relationship, with distance downstream from the source. In the acid streams such downstream increase was less usual, the rate of increase per unit length of stream was less, curvilinear relationships were more frequent and on some occasions downstream decrease was observed. The calcareous and acid streams thus formed two distinct groups on the basis of heterotrophic activity, cell volume, and rate of increase in suspended bacteria. This division was not necessarily caused solely by difference in pH, but might be due to the combined effects of the many environmental variables that change in parallel with pH. (Author's abstract)
W88-10713

GEOCHEMICAL ASPECTS OF AQUEOUS IRON, PHOSPHORUS AND DISSOLVED ORGANIC CARBON IN THE HUMIC LAKE TJEUKEMEER, THE NETHERLANDS,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, and T. De Boer.
Freshwater Biology FWBLAB, Vol. 16, No. 5, p 661-672, October 1986. 4 fig, 6 tab, 42 ref.

Descriptors: *The Netherlands, *Geochemistry, *Phosphorus, *Iron, *Lake Tjeukemeer, *Limnology, *Organic carbon, Aquatic habitats, Humic acids, Cycling nutrients, Water chemistry, Particulate matter, Seasonal variation, Lakes, Colloids, Phosphorus, Carbon, Iron, Chelation, Fulvic acids.

The main source of P, Fe and DOC in the humic Lake Tjeukemeer is superfluous water pumped from surrounding peaty polders. Most particulate P is intracellular but almost all particulate Fe is abiotic. The size and molecular weight of the P, Fe and DOC (mainly fulvic acids (FA)) were determined by ultrafiltration and Sephadex G-100 gel filtration. Throughout the year most dissolved P and Fe was in colloids > 35 nm with apparent molecular weight between 30,000 and 150,000. The bulk of FA occurred in particles < 35 nm. Calculating the atomic ratios of P, Fe and organic C in the different size classes revealed that Fe-FA chelates are a minor species of the Fe pool. Less than 10% of the fulvic acids occurred as Fe-FA chelates. Based on their apparent size and molecular weight, the Fe-FA chelates are colloidal aggregates; about 50% of the dissolved P had the same size as the Fe-FA aggregates. These aggregates were only noticeable in winter when humus-rich polder water was flushed through the lake. During the rest of the year the dissolved Fe and P consisted mainly of acid-labile inorganic colloids which might have been organically coated. (Author's abstract)
W88-10714

RESOURCE-MEDIATED DEMOGRAPHIC VARIATION DURING THE MIDSUMMER SUCCESSION OF A CLADOCERAN COMMUNITY,
Oklahoma Univ., Kingston. Biological Station.
S. T. Threlkeld.
Freshwater Biology FWBLAB, Vol. 16, No. 5, p

673-683, October 1986. 6 fig, 2 tab, 30 ref. NSF Grant DEB 8022163.

Descriptors: *Limnology, *Seasonal variation, *Population dynamics, *Fecundity, *Waterfleas, Lakes, Lake Texoma, Oklahoma, Life table analysis, Body size, Errors, Bioindicators, Zooplankton, Aquatic populations, Growth rates.

The midsummer succession of cladoceran zooplankton in Lake Texoma, a reservoir in southern Oklahoma, was examined by demographic characterization of lake populations and a parallel set of life table experiments in which the dominant cladoceran species were raised on naturally occurring lake phytoplankton at lake temperatures. Diaphanosoma leuchtenbergianum occurred throughout the study period (mid-June to mid-August 1981), but Daphnia parvula, D. galeata mendotae, and Ceriodaphnia lacustris were detected rarely after 15 July. Analyses of size structure and size-specific fecundity of the cladoceran populations showed that (1) size structure shifted to smaller individuals in mid-July, (2) size-specific fecundity was relatively constant in the smaller size classes and was constant or declined in larger females of each species, and (3) size at maturation did not vary significantly during the study of any population. Individual growth rates of the two Daphnia species and Ceriodaphnia in the life table experiments were significantly lower in mid-July when populations were declining and when size structure of each population was dominated more by smaller individuals. The reduction in individual growth rates was short-lived in the life table experiments; growth rates returned to pre-decline levels by the end of July. Two effects of temporary reductions in individual growth rates when size-specific fecundity and size at maturation are constant are (1) that size structure is temporarily shifted to smaller individuals, and (2) the potential rate of population growth is reduced because of delays in reproduction. Because data on size structure and size-specific fecundity commonly are used to evaluate the relative side effects of predators and resource changes on populations, it is noteworthy that erroneous conclusions about the mechanism of population decline may be reached when individual growth rates vary. (Author's abstract)
W88-10715

FISH COMMUNITIES IN THE PERENNIAL WETLAND OF THE SUDD, SOUTHERN SUDAN,
Severn-Trent Water Authority, Birmingham (England).
P. Hickley, and R. G. Bailey.
Freshwater Biology FWBLAB, Vol. 16, No. 5, p 695-709, October 1986. 4 fig, 4 tab, 16 ref.

Descriptors: *Sudan, *Fish communities, *Sudd, *Wetlands, *Species diversity, *Aquatic habitats, Fish populations, Reproduction, Water hyacinth, Macrophytes, Sudan, Tropical regions, Comparison studies, Fish migration, Spawning, Air-breathing fish, Papyrus, Cattails, Sedges, Carp, Catfish, Channels, Marshes, Lakes, Flood plains, Biomass.

Cyperus papyrus and Typha domingensis swamps were recognized as the major ecological zones in the perennial wetland of the Sudd. Fish sampling, chiefly by gill-netting and electric fishing, was concentrated in the open waters of channels and lakes together with submerged, fringing, and marginal vegetation in the accessible papyrus zone. Sixty-two species were recorded, including 15 catfishes, 13 characoids, 7 cyprinids, 7 mormyrids, and 7 cichlids. The highest diversity and abundance of fishes was obtained in the shallow Sudd lakes, which revealed considerable uniformity in population structures. The most numerous species in gill nets were Alestes dentex, Synodontis frontosus, and S. Schall, whereas Heterotis niloticus, Mormyrus cashive, and Distichodus rostratus assumed importance in terms of biomass. Micralestes acutidens and cichlids were abundant among the small fishes inhabiting fringes of Eichhornia crassipes, and air-breathing species occurred beneath the vegetation mat. Flowing-water habitats exhibited a similar but restricted fauna. Catches were dominated by Synodontis frontosus in open water and by Micralestes acutidens and Chelaethiops bibie in the margins. C. bibie had a clear preference for running water. Peak catches in a representative river-lake could be interpreted as the arrival of fish for breeding or their migration through the lake for reproduction elsewhere. The capture of fry or juveniles of many species in fringing or marginal vegetation indicates that the 'permanent' floodplain of the Sudd provides suitable spawning and rearing grounds. Access to the extensive Typha zone was limited, but from available evidence it was inferred that air-breathing fishes, notably Heterotis and Gymnarchus, may penetrate the swamps to reach areas remote from perennial transmission channels. (Author's abstract)
W88-10716

PRODUCTION OF THE CHIRONOMID PROCLADIUS BELLUS IN AN ANNUAL DRAWDOWN RESERVOIR,
Department of Fisheries and Oceans, Charlottetown (Prince Edward Island). Fisheries Research Branch.
T. W. Sephton, and C. G. Paterson.
Freshwater Biology FWBLAB, Vol. 16, No. 6, p 721-733, December 1986. 4 fig, 4 tab, 62 ref. NSERC Grant A-3478.

Descriptors: *Reservoirs, *Lakes, *Midges, *Seasonal variation, *Drawdown, *Reservoir operation, Secondary productivity, Laurel Creek Reservoir, Ontario, Water level fluctuations, Eutrophic lakes, Adaptation, Survival, Biomass, Shallow water, Aquatic habitats, Reproduction.

In Laurel Creek Reservoir, Ontario, a small, eutrophic annual drawdown reservoir, some individuals of the chironomid Procladius bellus, survive the winter drawdown. With refilling of the reservoir in the spring, colonization by P. bellus is continuous and there were three generations a year. Production estimated by the size-frequency method was 117.12 kg (175 mg/sq m) in 1980 and 70.14 kg (105 mg/sq m) in 1981. Annual secondary production:average biomass ratio was about 13 in both years. Substantial station-to-station variations in production occurred and overall production was lower than in shallow habitats. (Author's abstract)
W88-10717

NUTRIENT LIMITATION OF MYRIOPHYLLUM SPICATUM GROWTH IN SITU,
McGill Univ., Montreal (Quebec). Dept. of Biology.
M. R. Anderson, and J. Kalff.
Freshwater Biology FWBLAB, Vol. 16, No. 6, p 735-743, December 1986. 2 fig, 5 tab, 39 ref.

Descriptors: *Primary productivity, *Limiting nutrients, *Wetlands, *Lakes, *Aquatic plants, *Myriophyllum, Macrophytes, Lake Memphremagog, Quebec, Eutrophication, Nitrogen, Phosphorus, Potassium, Plant physiology, Water depth, Plant growth.

The hypothesis that the submersed macrophyte biomass in natural weedbeds is nutrient-limited was tested in situ by an enrichment experiment conducted in Quinn Bay, Lake Memphremagog (Quebec, Canada). The response of Myriophyllum spicatum was significant and positive for N-enrichment, resulting in a 30-40% increase in biomass over controls. There was no response to P or K enrichment. Plant length and number of shoots/replicate also were significantly increased by N additions, but again showed no response to P and K. Water depth differences also affected the plant responses in some cases. The macrophyte response to fertilization was similar to that recorded for emergent macrophytes and terrestrial crops, but much smaller than for phytoplankton. (Author's abstract)
W88-10718

GRADIENTS IN THE DISTRIBUTION OF RIVERINE BENTHOS,
Construction Engineering Research Lab. (Army), Champaign, IL.
D. J. Schaeffer, and J. A. Perry.
Freshwater Biology FWBLAB, Vol. 16, No. 6, p 745-757, December 1986. 1 fig, 4 tab, 27 ref, append. University of Minnesota Agricultural Experiment Station Project MN-42-45 of the McIntire-Stennis Cooperative Forestry Research Program.

Descriptors: *Spatial distribution, *Benthos, *Rivers, *Statistical methods, *Trend analysis, *Longitudinal variation, Comparison studies, Mountain streams, Tomichi Creek, Colorado, Statistical analysis, Cluster analysis, Skewness, Similarity index, Hypothesis testing, Benthic fauna.

Numerous hypotheses regarding the controls on species distribution in streams depend on longitudinal analyses of collections of stream organisms. Techniques for the detection of trends and for the detection of station groupings among biological collections have been widely reported, but rarely compared with each other. An analysis was conducted of 10 or 11 samples from each of 13 stations along an abiotic gradient in Tomichi Creek, a high-altitude stream in Colorado, and several techniques were compared. An analysis of longitudinal distribution must first assess the existence of a gradient biotic composition. Random skewers on species proportions were the most sensitive in demonstrating such a gradient. Cochran's Q and Hendrickson's M statistics were most useful in further describing the trend due to their additive properties; i.e., the importance of one or more stations in dictating the trend may be determined. Cluster analysis, as well as percent faunal similarity, was most efficient isolating station groupings. Techniques such as faunal replacement and species loss calculations generally are more useful in testing hypotheses about controls on species distributions, and should be employed where potential causal factors may be isolated. (Author's abstract)
W88-10719

BENTHOS OF A NATURAL WEST AFRICAN LAKE, WITH EMPHASIS ON THE DIEL MIGRATIONS AND LUNAR AND SEASONAL PERIODICITIES OF THE CHAOBORUS POPULATIONS (DIPTERA, CHAOBORIDAE),
Waterloo Univ. (Ontario). Dept. of Biology.
L. Hare, and J. C. H. Carter.
Freshwater Biology FWBLAB, Vol. 16, No. 6, p 759-780, December 1986. 13 fig, 2 tab, 73 ref.

Descriptors: *Chaoborus, *Migration, *Benthos, *Diurnal cycles, *Population dynamics, *Aquatic habitats, *Biomass, Seasonal variation, Reproduction, Aquatic animals, Lake sediments, Light quality, Species composition, Limnology, Statistical methods, Lakes, Nigeria, Lunar periodicity.

Three Chaoborus species dominated in abundance and biomass the mid-lake benthic fauna of a small, natural Nigerian lake. Each population showed distinct seasonal variations, C. anomalus being most abundant during the early rainy season, while C. ceratopogones and C. edulis were most abundant during the dry season. A fourth species, C. fuscinervis (not reported previously from West Africa), was collected only in the adult stage. Also abundant at mid-lake were the Chironomidae, Chironomus seydeli, Procladius brevipetiolatus and Tenypus brevipalpis, all of which showed a seasonal pattern most resembling that of C. anomalus. Second, third and fourth instar larvae and pupae of the Chaoborus species underwent a diel vertical migration between the lake sediments (diurnal) and the water column (nocturnal) which was strongly related to prevailing light conditions. Lunar periodicities of Chaoborus emergence determined from emergence trap collections are described for the first time. Corresponding lunar periodicities of larval abundance were observed in two of the species. The statistical techniques employed in describing the lunar periodicities permit the estimation of generation times. C. anomalus is believed to be parthenogenetic in the study lake (no males collected), while the other Chaoborus species are bisexual (1:1 sex ratios). The biology of this species is discussed in relation to the parthenogenetic condition. (Author's abstract)
W88-10720

POLYMIXIS AND ALGAL PRODUCTION IN A TROPICAL LAKE: LATITUDINAL EFFECTS ON THE SEASONALITY OF PHOTOSYNTHESIS,
California Univ., Davis. Inst. of Ecology.
W. F. Vincent, W. Wurtsbaugh, P. J. Neale, and P. J. Richerson.
Freshwater Biology FWBLAB, Vol. 16, No. 6, p 781-803, December 1986. 12 fig, 4 tab, 43 ref. NSF Grant DEB 7921933.

Descriptors: *Polymictic lakes, *Mountain lakes, *Primary productivity, *Phytoplankton, *Limnology, *Tropic zone, Solar radiation, Comparison studies, Annual variation, Chlorophyll a, Photosynthesis, Lake Titicaca, Peru, Bahia de Puno, Cyanophyta, Algae, Nitrogen fixation, Correlation analysis, Lakes, Latitudinal studies, Temperate zone, Variance.

Phytoplankton production was measured during 1981-82 in Bahia de Puno, a large polymictic system that is part of Lake Titicaca in the tropical Andes (Peru). Photosynthesis followed a weak seasonal pattern through each 12-month cycle but the largest variations occurred between years. The large temporal variations in productivity appeared to be controlled by biological events rather than direct effects of seasonal or aseasonal physical processes. Major shifts in production over the 2-yr period were attributable to the proportional abundance and activity of N2-fixing blue-green algae. Production was uncorrelated with the seasonal radiation cycle. In vivo fluorescence and photosynthetic assays revealed large changes in phytoplankton community structure over time and depth. The shifts in vertical structure were associated with changes in transparency and water column stability. Physiological as well as floristic effects dictated the variations in fluorescence per unit chlorophyll a. An analysis of 27 primary productivity data sets from different latitudes showed that Bahia de Puno resembled other tropical lakes in its relatively weak coupling between algal photosynthesis and seasonal variations in light. Productivity in the temperate zone correlated with the annual cycle of incoming radiation, but the tropical production data did not. For many of the tropical lakes, but few temperate lakes, the between-month variance in primary production was significantly higher than the between-month variance in primary production was significantly higher than the between-month variance for incoming radiation. There was a significant positive relationship between maximum production variance explained by light (maximum r squared for each data set) and latitude. The muted seasonal cycle of light explains only a small portion of the total variation in productivity and other factors such as weather-related events are disproportionately important. (Author's abstract)
W88-10721

DIATOM FLORA OF AN AUSTRALIAN RIVER SYSTEM: SPATIAL PATTERNS AND ENVIRONMENTAL RELATIONSHIPS,
Latrobe Valley Water and Sewage Board, Traralgon (Australia).
B. C. Chessman.
Freshwater Biology FWBLAB, Vol. 16, No. 6, p 805-819, December 1986. 5 fig, 8 tab, 30 ref.

Descriptors: *Aquatic habitats, *Rivers, *Diatoms, *Environmental effects, Algae, *LaTrobe River, *Australia, Principal component analysis, Discriminant analysis, Cluster analysis, Water pollution effects, Catchment areas, Spatial distribution, Physicochemical properties, Land use, Flow discharge, Altitude, Temperature, Hydrogen ion concentration, Phosphorus, Nitrogen, Species diversity, Biochemical oxygen demand, Turbidity, Calcium, Conductivity, Alkalinity, Nitzschia, Navicula, Correlation analysis, Wastewater disposal.

Quantitative diatom samples were collected from various microhabitats at 53 sites on the LaTrobe River, Victoria (Australia), and its tributaries in late summer and early autumn. Measurements of several physico-chemical variables of likely significance to diatom distribution also were made. Principal components analysis of the physico-chemical data showed that the dominant environmental pattern in the river system was a gradient from cool, dilute upland streams to warmer, more turbid and enriched lowland waters. A total of 267, mostly cosmopolitan, diatom species were recorded; Navicula and Nitzschia were the dominant genera. Cluster analysis allowed the sampling sites to be divided into six groups on the basis of their floras. These groupings corresponded closely to flow, land use and wastewater discharge patterns, and there were clear physico-chemical differences among the groups. Multiple discriminant analysis found that altitude, temperature, biochemical oxygen demand, turbidity, non-filterable residue, pH, major ions, phosphorus, and nitrogen were important factors in distinguishing between site groups. Diatom species richness was lowest in relatively undisturbed, forested upland streams, probably as a result of nutrient limitation. For the catchment as a whole, significant correlations were established between species richness and altitude, temperature, biochemical oxygen demand, turbidity, non-filterable residue, conductivity, calcium, alkalinity, organic nitrogen, and phosphorus. (Author's abstract)
W88-10722

AMMONIUM AND PHOSPHATE REGENERATION BY THE ZOOPLANKTON OF AN AMAZON FLOODPLAIN LAKE,
California Univ., Santa Barbara. Dept. of Biological Sciences.
P. H. Lenz, J. M. Melack, B. Robertson, and E. A. Hardy.
Freshwater Biology FWBLAB, Vol. 16, No. 6, p 821-830, December 1986. 6 fig, 2 tab, 31 ref. NSF Grants DEB78-23642 and DEB81-11398.

Descriptors: *Lake Calado, *Brazil, *Phosphates, *Limnology, *Population dynamics, *Tropic zone, *Cycling nutrients, *Zooplankton, Flood plains, Macroinvertebrates, Aquatic animals, Aquatic habitats, Seasonal variation, Lakes.

Regeneration of ammonium and phosphate by macrozooplankton (Cladocera, adult copepods, and copepodites) was measured in lake Calado, an Amazon floodplain lake (Brazil). Macrozooplankton abundances ranged between 10,000 and 300,000 individuals/sq m. Phosphate regeneration ranged from 0.2 to 1.3 micromoles PO4/sq m/h at station 1, located 2 km from the Solimoes River, and from 1.6 to 8.3 micromoles PO4/sq m/h at station 3, located 7 km from the Solimoes River. Ammonium regeneration at stations 1 and 3 ranged from 1.7 to 11.9 and from 13.4 to 77.2 micro-moles NH4/sq m/h, respectively. Zooplankton regenerated ammonium and phosphate at similar rates during rising and falling water. Regeneration by macrozooplankton was low compared to other tropical lakes and compared to microbes and microzooplankton in Lake Calado. (Author's abstract)
W88-10723

SELECTIVE GRAZING ON PERIPHYTON: A DETERMINANT OF FRESHWATER GASTROPOD MICRODISTRIBUTIONS,
Oxford Univ. (England). Dept. of Zoology.
D. M. Lodge.
Freshwater Biology FWBLAB, Vol. 16, No. 6, p 831-841, December 1986. 11 fig, 52 ref.

Descriptors: *Algae, *Gastropods, *Periphyton, *Food habits, *Limnology, *Eutrophic ponds, Macrophytes, Aquatic plants, Spatial distribution, Decomposing organic matter, Radley Pond, Diatoms, Chlorophyta, Aquatic habitats, Snails.

In Radley Pond, a eutrophic pond in southern England, the snail Lymnaea peregra (Mull.) is associated with submersed macrophytes, mainly Elodea canadensis Michx. In contrast, the snail Planorbis vortex (Linn.) is associated with the emergent macrophyte Glyceria maxima (Hartm.) Holmberg. L. peregra grazed selectively on filamentous green algae found only on E. canadensis. P. vortex selected diatoms. Detritus, which was 5 times more abundant on G. maxima than on E. canadensis, comprised about 60% of the diet of P. vortex. Results of experiments giving both snail species a choice between periphyton-detritus removed from the two macrophytes were consistent with the field observations. L. peregra chose periphyton-detritus from E. canadensis whereas P. vortex chose that from G. maxima. Although other factors may have influenced the distributions of L. peregra and P. vortex in Radley Pond, food choice was probably the most important proximate factor. (Author's abstract)
W88-10724

RESPONSE OF THE FRESHWATER MARSH SPECIES, PANICUM HEMITOMON SCHULT., TO INCREASED SALINITY,
Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments.
S. R. Pezeshki, R. D. DeLaune, and W. H. Patrick.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 195-200, April 1987. 2 fig, 1 tab, 16 ref. NSF Grant BRS-8414006.

Descriptors: *Salinity, *Panicum, *Limnology, *Salt tolerance, *Saline water intrusion, Plant physiology, Photosynthesis, Water pollution effects, Population exposure, Aquatic habitats, Mississippi River, Deltas, Subsidence, Toxicity, Plant pathology.

Panicum hemitomon Schult. plants were collected from Louisiana's Mississippi River deltaic plain freshwater marsh and subjected to salinities of 5-12 ppt under controlled environment conditions. The condition was designed to simulate salt stress resulting from storm surges, brine spills associated with oil recovery operations and salt water intrusion due to rapid subsidence and parallel increases in apparent sea level in Louisiana's coastal areas. Plant stomatal conductance was reduced between 55% and 80% and net photosynthesis declined between 20% and 67% in response to the different salinities within 1 day of salt application. Both responses lasted throughout the entire experiment. Salinities ranging between 10 and 12 ppt resulted in tissue death in the plants 4 days after salt exposure. In addition to the short-term impact of salt water influx on gas exchange of P. hemitomon reported here, the potential long-term effects on habitat change are discussed. (Author's abstract)
W88-10726

COMPARISON OF CHLOROPHYLL A AND CAROTENOID CONCENTRATIONS AS INDICATORS OF ALGAL VOLUME,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
For primary bibliographic entry see Field 7B.
W88-10727

METABOLISM OF A SUB-TROPICAL LOW GRADIENT BLACKWATER RIVER,
Georgia Univ., Athens. Dept. of Zoology.
R. T. Edwards, and J. L. Meyer.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 251-263, April 1987. 2 fig, 5 tab, 57 ref. NSF Grants DEB-8104427 and BSR-8406631.

Descriptors: *Ogeechee River, *Dissolved oxygen, *Aquatic habitats, *Primary Productivity, Seasonal variation, Statistical methods, Light quality, Georgia, Photosynthesis, Respiration, Organic carbon, Cycling nutrients, Rivers, Carbon cycle.

Single-station diel oxygen curves were used to monitor the oxygen metabolism of the Ogeechee River, a sixth-order blackwater river in the Coastal Plain of Georgia, over a period of 4 years. Ecosystem production (P) and respiration (R) were estimated, and P/R ratios calculated to determine the extent of autotrophy characteristic of this type of river. The potential error in oxygen metabolism caused by photo-oxidation of dissolved organic carbon (DOC) in the water was measured and found to be minor. Rates of ecosystem primary production measured were intermediate compared to other rivers, ranging from 0.49 to 13.99 g O2/sq m/day. Primary production rates were highest during the summer when water levels were low. Regression analysis indicated that water depth and light absorption by DOM were significant predictors of primary production in this river. Incident light intensities were not significantly correlated with production rate. Respiration rates were un-

usually high, varying between 3.70 and 11.5 g O2/sq m/day. System respiration also varied seasonally, but less than primary production. Rates were slightly higher in spring and summer. With one exception, P/R ratios were considerably lower than 1 throughout the study period, indicating that the Ogeechee River was highly heterotrophic. P/R ratios ranged from 0.09 to 1.3, and averaged 0.25. A carbon budget calculated for this river showed floodplain inputs were 7 times autocthonous production. Organic carbon turnover length was 690 km, considerably longer than has been reported for lower-order rivers. (Author's abstract)
W88-10728

NUMERICAL MODEL OF NITROGEN FIXATION AND ITS APPLICATION TO LAKE VALENCIA, VENEZUELA,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
S. N. Levine, and W. M. Lewis.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 265-274, April 1987. 3 fig, 35 ref. NSF Grants DEB 78-05324 and 80-03883.

Descriptors: *Nitrogen fixation, *Cyanophyta, *Lake Valencia, *Limnology, *Model studies, *Light intensity, Spatial distribution, Temporal distribution, Seasonal variation, Aquatic habitats, Phytoplankton, Limiting nutrients, Cycling nutrients, Mathematical models, Mathematical equations, Eutrophication, Lakes, Venezuela.

A numerical model for calculation of daily and annual nitrogen fixation in lakes is presented. The model is based on empirically-derived equations for the rates of nitrogen fixation by heterocysts (nitrogen-fixing cells) in relation to light and on functions for the vertical and temporal distributions of heterocysts and light in a lake. Applications of the model to Lake Valencia, Venezuela, between December 1980 and December 1981 indicated that nitrogen fixation is largely a surface phenomenon in this lake: 80% of diurnal fixation occurred within 1 m of the water surface. Nitrogen fixation is largely restricted to periods of lake stratification, when the phytoplankton have sufficient light for growth, but dissolved inorganic nitrogen is scarce. Nitrogen fixation was maximal late in the stratification period of 1981: 85% of fixation occurred within the last 3 months of the 9-month period. The annual nitrogen fixation in Lake Valencia is 26 kg/ha, which is comparable to the nitrogen fixation in temperate eutrophic lakes with seasonal blue-green algal blooms. However, nitrogen fixation accounted for only 23% of the total nitrogen supply to Lake Valencia in 1981. (Author's abstract)
W88-10729

ZOOPLANKTON POPULATIONS AND THE DIETS OF THREE CHAOBORUS SPECIES (DIPTERA, CHAOBORIDAE) IN A TROPICAL LAKE,
Waterloo Univ. (Ontario). Dept. of Biology.
L. Hare, and J. C. H. Carter.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 275-290, April 1987. 8 fig, 2 tab, 63 ref.

Descriptors: *Chaoborus, *Zooplankton, *Limnology, *Food habits, Migration, Diets, Tropical regions, Crustaceans, Aquatic habitats, Algae, Predation, Opi Lake, Nigeria, Seasonal variation, Lakes.

Zooplankton populations in a small, natural, tropical lake (Opi Lake, Nigeria) are dominated by a few, small-sized taxa including the copepod Thermocyclops consimilis, the cladoceran Moina micrura and several rotifer species. Moina micrura and adults of Thermocyclopos consimilis undergo diel vertical migrations within the water column. Population densities of T. consimilis show marked intra-annual variations which may to some extent be related to variations in rainfall and to lunar periodicities in predator abundance. The diets of Chaoborus larvae include other Chaoborus, Cladocera, Copepoda, Rotifera and the dinoflagellate Peridinium. The diets of late instars of the largest species, C. edulis, were dominated by Crustacea, while those of the two smaller species, C. ceratopogones and C. anomalus, were dominated by Rotifera and the dinoflagellate alga Peridinium, as were the diets of early instars of all species. Algae have not been previously reported to be a large component of the diet of Chaoborus populations in nature. Some of the dietary differences among Chaoborus instars and species are related to the size of each prey species in relation to the mouth gape of each instar. However, there are also important differences in selectivity among instars of different species of the same size. (Author's abstract)
W88-10730

RELATIONS BETWEEN SUSPENDED BACTERIA, EPIPHYTIC BACTERIA AND SUBMERGED VEGETATION OVER THE SPRING GROWING SEASON IN A CALCAREOUS HEADSTREAM,
Hull Univ. (England).
C. A. Rimes, and R. Goulder.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 291-305, April 1987. 7 fig, 2 tab, 31 ref.

Descriptors: *Headwaters, *Aquatic bacteria, *Aquatic habitats, *Population dynamics, Seasonal variation, Streams, Calcareous streams, Vegetation effects, Mill Beck, England.

Quantitative observations on suspended bacteria, epiphytic bacteria and submerged vegetation, in the calcareous headstream fMill Beck (England), were made at regular intervals from January to June 1984. Downstream increase in concentration of suspended bacteria was observed along a 135 m richly-vegetated section but not over a 150 m vegetation-free section, hence there was measurable drift loss of bacteria only from within the vegetated section. The total number of epiphytic bacteria within the vegetated section decreased from January to March before increasing by June. This pattern was related to decrease and subsequent increase in density of epiphytic bacteria per unit dry weight of vegetation. The total dry weight of submerged vegetation increased throughout the study period. The daily drift loss of bacteria from the vegetated section averaged 53% of the total epiphytic bacteria, a loss rate which might reasonably be supported by the epiphyte population. The dimensions and volume of suspended bacteria increased, between the source and the downstream limit of the vegetated section, to resemble those of epiphytic bacteria. The results suggested that released epiphytic bacteria might largely be the source of suspended bacteria in this headstream. (Author's abstract)
W88-10731

FACTORS AFFECTING THE MICRODISTRIBUTION OF GAMMARUS PULEX (AMPHIPODA): AN EXPERIMENTAL STUDY,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
J. Adams, J. Gee, P. Greenwood, S. McKelvey, and R. Perry.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 307-316, April 1987. 3 fig, 5 tab, 28 ref.

Descriptors: *Gammarus, *Spatial distribution, *Water currents, *Animal behavior, *Aquatic habitats, Artificial streams, Population dynamics, Model studies, Field tests, Streams.

The microdistribution of Gammarus species is size assortative: larger animals are associated with large substrate particles. Using an artificial stream with scrubbed substrate, the hypothesis was studied that the assortative mechanism is stimulated by current avoidance rather than food searching. In uniformly mixed substrate, G. pulex tend to move upstream, but in patchy substrate they are found in a predictable substrate grade. There is no discrimination between patches by different size classes of G. pulex in static water. The size assortative field pattern can only be reproduced under flow conditions in the laboratory. It occurs in the absence of food and irrespective of the sequence or location of substrate patches. As density increases, G. pulex are displaced from the optimal patches but move into the open stream rather than into the cover of alternative patch types. It is suggested that some earlier models explaining mechanisms for microdistribution patterns may have been unnecessarily complex. Contrasts between natural and simulated stream situations and their experimental advantages are noted. (Author's abstract)
W88-10732

GRAZING BY OLIGOCHAETES AND SNAILS ON EPIPHYTES,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
T. Kairesalo, and I. Koskimies.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 317-324, April 1987. 4 fig, 1 tab, 24 ref.

Descriptors: *Snails, *Epiphytes, *Oligochaetes, *Limnology, *Food habits, *Aquatic habitats, Isotope studies, Macrophytes, Algae, Tissue analysis, Enclosure studies, Excretion, Phosphorus, Radioactive tracers, Cycling nutrients, Lakes.

The isotope 33P was used to assess the effect of grazing by oligochaetes (mainly Stylaria lacustris L.) and the snail, Lymnaea peregra (Muller), on epiphytes within an Equisetum fluviatile L. stand. Two 1 sq m polystyrene enclosures were set up within the emergent macrophyte zone of the lake. At the start of the experiment 33P-solution was mixed with the water in both tanks. Algal and animal samples for 33P-analysis were collected during the peak occurrence of epiphytes in June. Phosphorus release rates from the animals through defecation and excretion were measured in the laboratory. The grazing rate of oligochaetes was 2.2-4.1 mg P/sq m (of bottom)/day of which about two-thirds was released and recycled. The oligochaete density ranged from 13,400 to 20,900/sq m. The snails (25 ind. sq/m) grazed 1.2-1.5 P/sq m/day of which about a quarter was released through defecation and excretion. Daily consumption by the oligochaetes and snails corresponded to 22-45% of the average phosphorus uptake by the epiphytes. (Author's abstract)
W88-10733

IMPORTANCE OF DISSOLVED ORGANIC MATTER PRODUCED BY DUCKWEED (LEMNA MINOR) IN A SOUTHERN ENGLISH RIVER,
Freshwater Biological Association, Wareham (England). River Lab.
J. H. Baker, and I. S. Farr.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 325-330, April 1987. 3 fig, 1 tab, 26 ref.

Descriptors: *Duckweed, *Aquatic plants, *Aquatic habitats, *Limnology, *Organic carbon, Isotope studies, Carbon cycle, Primary productivity, England, River Frome, Radioactive tracers, Particulate matter, Rivers.

The quantity of dissolved organic carbon (DOC) released by axenic Lemna minor cultures in the laboratory has been determined by an absolute method and by 14C labelling. Good agreement was obtained between the two methods and from 1.1% to 2.6% of the total carbon fixed was released. The DOC produced by L. minor has been analyzed by ultrafiltration and compared with a similar analysis of DOC in natural river water (River Frome, Dorset). The results of ultrafiltration analyses indicate that the proportion of low molecular weight material in DOM produced by axenic L. minor is significantly greater than is found in its natural habitat. (Author's abstract)
W88-10734

TIME-COURSE OF INORGANIC NITROGEN UPTAKE AND INCORPORATION BY NATURAL POPULATIONS OF FRESHWATER PHYTOPLANKTON,
Montana State Univ., Bozeman. Dept. of Biology.
J. C. Priscu.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 331-339, April 1987. 4 fig, 1 tab, 36 ref.

Descriptors: *Cycling nutrients, *Phytoplankton, *Eutrophication, Aquatic habitats, Isotope studies, Ammonium, Nitrate, Seasonal variation, Radioac-

tive tracers, Culturing techniques, Metabolism, Plant physiology, Lakes.

Time-course measurements of NH4(+) and NO3(-) uptake were made on the natural phytoplankton populations in a eutrophic lake (Lake Rotongaio, New Zealand) at a time when these nutrients were at their lowest annual concentration. Both NH4(+) and NO3(-) uptake was increased at least five-fold during the first min of incubation following near saturating pulses of these nutrients. Elevated uptake was also observed following low level pulses of NH4(+) and NHO3(-), but substrate depletion during the first hour of incubation may have been partially responsible for this apparent enhancement. Incorporation of 15N into protein following the saturating NH4(+) pulse was increased less than total cellular 15N uptake, whereas no elevation of 15N incorporation into protein was observed following a saturating NO3(-) pulse. The percentage of 15N incorporated into protein, with respect to total cellular uptake, was 32% and 12% for NH4(+) and NO3(-), respectively, following 5 h of incubation. (Author's abstract)
W88-10735

SHORT-TERM EXPERIMENTAL ACIDIFICATION OF A WELSH STREAM: COMPARING THE BIOLOGICAL EFFECTS OF HYDROGEN IONS AND ALUMINIUM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5C.
W88-10736

OCCURRENCE AND MECHANISMS OF MICROBIAL OXIDATION OF MANGANESE,
Wisconsin Univ.-Milwaukee. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2K.
W88-10742

PLANKTONIC CLADOCERANS IN HARVEYS LAKE, PENNSYLVANIA 1948-1985,
Wilkes Coll., Wilkes-Barre, PA. Dept. of Biology.
C. B. Reif.
Proceedings of the Pennsylvania Academy of Science PPASAK, Vol. 60, No. 1, 1986. 1 fig, 10 ref.

Descriptors: *Pennsylvania, *Lakes, *Daphnia, *Plankton, *Predation, *Harveys Lake, *Cladocera, *Population dynamics, *Species composition, Aquatic animals, Aquatic habitats, Food habits, Food chains, Fish.

Harveys Lake, the largest natural lake in Pennsylvania, has been observed by the author and his colleagues since 1943. Major changes within the cladoceran populations have been noted. Selective predation by legally stocked smelt on the daphnids has been noted. An illegal stocking of alewife has apparently resulted in a large papulation of the alewife, which, with the smelt, appears to have eliminated the daphnids from the plankton. The prominent cladoceran represented in the plankton since 1980 has been Bosmina longirostris. Chemical factors which may have been involved include variation in dissolved oxygen and occasional presence of pesticides. Nutrients varied very little during the study period although urbanization increased greatly. (Author's abstract)
W88-10745

ICTHYOFAUNAL CHECKLIST AND COMPARISON OF TWO NORTH BRANCH POTOMAC RIVER TRIBUTARIES WHERE ALLEGED OHIO-POTOMAC RIVER STREAM CAPTURES OCCURRED,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
D. A. Cincotta, K. L. Dull, S. L. Markham, and R. D. Williams.
Proceedings of the Pennsylvania Academy of Science PPASAK, Vol. 60, No. 2, p 129-134, 1986. 1 fig, 2 tab, 31 ref.

Descriptors: *Stream biota, *Stream capture, *Paleohydrology, *Potomac River, *Aquatic habitats, *Species composition, *Fish, *Ohio River, Willis Creek, Savage River, Streams, Population dynamics, Watersheds, Drainage system, Rivers, Comparison studies, Tributaries.

Fishery surveys were conducted on Wills Creek and Savage River drainages of the upper Potomac River during 1977-79. A total of 4523 specimens representing 8 families, 21 genera and 34 species were taken from Wills Creek from 18 locations; 3305 specimens, 7 families, 21 genera, and 27 species were found in the Savage River at 20 locations. Distribution, relative abundance, and the percent occurrence of all fishes by watershed is presented. A summary of known fishes is also included. An ichthyofaunal comparison of the drainages is made and a discussion relative to the zoogeographic implications provided. The ichthyofaunal data of these drainages suggest that more fishes made their way to the Atlantic slope via the Wills Creek stream capture route rather than the often hypothesized Savage River avenue. (Author's abstract)
W88-10746

BACTERIAL ZONATION, PHOTOSYNTHESIS, AND SPECTRAL LIGHT DISTRIBUTION IN HOT SPRING MICROBIAL MATS OF ICELAND,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
B. B. Jorgensen, and D. C. Nelson.
Microbial Ecology MCBEBU, Vol. 16, No. 3, p 133-147, 1988. 8 fig, 31 ref.

Descriptors: *Iceland, *Bacteria, *Photosynthesis, *Thermal springs, *Hot springs, Springs, Spectral analysis, Photosynthetic bacteria, Bacterial analysis, Microbiological studies, Microbial mats.

The zonation and structure of phototrophic microbial mats were studied along two thermal gradients in sulfide-rich hot springs of southwest Iceland. The green, filamentous bacterium Chloroflexus and the unicellular, 'high-temperature form' of Mastigocladus formed mats growing up to a temperature limit of 62-66 C. The dominant phototrophs were Chloroflexus sp., Mastigocladus laminosus, and Phormidium laminosum, respectively, at three temperature level intervals: (1) > 60 C, (2) 60 C to 55-50 C, and (3) < 55-50 C. A Chloroflexus mat growing at 60 C under 60 micromolar H2S was anoxic in the light with the exception of a 0.5 mm thick band of high-temperature form Mastigocladus which produced oxygen. The oxygenic photosynthesis of these H2S-sensitive cyanobacteria was probably dependent on a preceding sulfide depletion by the anoxygenic Chloroflexus. Measurements of spectral radiance gradients with a fiberoptic microprobe showed maximum light attenuation by carotenoids and bacteriochlorophyll c. A M. laminosus mat growing at 52 C was oxic throughout and showed maximum light attenuation by carotenoids, chlorophyll a and phycocyanin, but no detectable phycoerythrocyanin absorption. (Author's abstract)
W88-10768

EFFECT OF SEASONAL CHANGES ON CYANOBACTERIAL PRODUCTION AND NITROGEN-YIELD,
Central Rice Research Inst., Cuttack (India).
R. N. Bisoyi, and P. K. Singh.
Microbial Ecology MCBEBU, Vol. 16, No. 3, p 149-154, 1988. 2 tab, 17 ref.

Descriptors: *Nitrogen fixation, *Nitrogen fixing bacterial, *Photosynthesis, *Cyanobacteria, *Seasonal variation, *Bacteria, Nitrogen, Biomass, Primary productivity, Rainfall, Temperature effects, Microbiological studies, *Solar radiation, Nitrogen yield, Rice fields.

A mixed culture of cyanobacteria containing Aulosira sp., Aphanothece sp., and Gloeotrichia sp. was grown throughout the year to assess the influence of seasonal variables on their biomass production and nitrogen (N)-yield under field conditions. The seasonal variables considered in this study (including maximum water temperature, minimum water temperature, solar radiation, sunshine hours, and rainfall) fluctuated widely. Attempts were made to establish a relationship between seasonal changes as independent variables and cyanobacteria productivity and N-yield as dependent variables. The analysis indicated that solar radiation was the prime factor. Estimates of cyanobacteria biomass production varied from 3.3 to 366.5 kg (dry wt)/ha/month, and N-yield ranged from 0.1 to 11.8 kg N/ha/month. The nitrogen accumulated during the study period was 71.2 kg N/ha. The variations explained by seasonal changes were 52.3 and 50.3% for biomass production and N-yield of cyanobacteria, respectively. (Author's abstract)
W88-10769

SEASONAL VARIATION IN CELL VOLUME OF EPILIMNETIC BACTERIA,
Texas Univ. at Arlington. Dept. of Biology.
T. H. Chrzanowski, R. D. Crotty, and G. J. Hubbard.
Microbial Ecology MCBEBU, Vol. 16, No. 3, p 155-163, 1988. 4 fig, 3 tab, 18 ref.

Descriptors: *Pseudomonas, *Plankton, *Seasonal variation, *Bacteria, *Temperature effects, *Epilimnion, Microbiological studies, Growth rate, Cell volume, Planktonic bacteria.

The relationship between bacterial cell volume and temperature was examined for field data collected over a 4-year period and through controlled chemostat incubations of a Pseudomonas sp. Volumes of planktonic bacteria decreased as water temperature increased. Changes in temperature accounted for 38% of the variation in average cell volume ($P < 0.001$). Average planktobacterial cell volume fell 42% from 0.217 cubic micrometers in midwinter to 0.127 cubic micrometers in mid-summer. Similar results were found for the size distribution of epibacterial cells. Controlled chemostat incubations of a Pseudomonas sp. indicated that cell volume was significantly affected by temperature, growth rate and the interaction of temperature and growth rate. The data suggest that a change in cell volume as a result of a change in temperature is an intrinsic property of planktonic bacteria. (Author's abstract)
W88-10770

EFFECT OF WHOLE-TREE HARVEST ON EPILITHIC BACTERIAL POPULATIONS IN HEADWATER STREAMS,
Michigan State Univ., East Lansing. Dept. of Zoology.
For primary bibliographic entry see Field 4C.
W88-10771

EXTREME METAL AND ACID TOLERANCE OF EUGLENA MUTABILIS AND AN ASSOCIATED YEAST FROM SMOKING HILLS, NORTHWEST TERRITORIES, AND THEIR APPARENT MUTUALISM,
Toronto Univ. (Ontario). Dept. of Botany.
C. Nakatsu, and T. C. Hutchinson.
Microbial Ecology MCBEBU, Vol. 16, No. 3, p 213-231, 1988. 4 fig, 1 tab, 21 ref.

Descriptors: *Water pollution effects, *Tundra, *Acid rain, *Yeasts, *Acidic water, Acidity, Growth, *Euglenophyta, *Algae, *Metals, *Symbiosis, Mutualism, Yukon, Northwest Territories, Hydrogen ion concentration, Tolerance.

In isolates of Euglena mutabilis and an associated yeast from strongly acidic tundra ponds (pH of 1.8-2.0) at the Smoking Hills, North West Territories, and in isolates from acidic ponds in the Yukon, a remarkable degree of tolerance to a number of toxic elements and to very low pH has been found. Growth was used as a measure of tolerance. The tolerances to both low pH and to elevated metal concentrations were markedly enhanced when both organisms were present together. This mutualism occurred even when E. mutabilis was isolated from one field location and a yeast from another. In every field collection made of Euglena, the yeast was also found. The tolerances to metals are 10-100 times higher than the highest reported previously for algae, and include tolerance to some metals not elevated in the ponds from which isola-

tions were made. Reciprocal combinations of algal-yeast partners suggest a generalized benefit of association and an increased benefit for co-selected pairs from a specific site. This algal-yeast association may be a major factor in allowing colonization of these extreme acid habitats, paralleling the cyanobacteria-bacterial associations of extremely alkaline water. (Author's abstract)
W88-10772

MOTILE EPIFAUNA OF MARINE MACROPHYTES IN THE INDIAN RIVER LAGOON, FLORIDA: I. COMPARISONS AMONG THE THREE SPECIES OF SEAGRASSES FROM ADJACENT BEDS,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
R. W. Virnstein, and R. K. Howard.
Bulletin of Marine Science BMRSAW, Vol. 41, No. 1, p 1-12, July 1987. 2 fig, 3 tab, 38 ref. Harbor Branch Contribution no. 559 and S.E.A. Contribution No. 4.

Descriptors: *Macrophytes, *Florida, *Grasses, *Crustaceans, *Lagoons, *Gastropods, Epifauna, Seagrass, Aquatic ecology, Ecosystems, Population density, Aquatic vegetation, Indian River.

A newly designed sampler was used to quantitatively sample the epifauna associated with three morphologically distinct seagrasses (Thalassia testudinum, Halodule wrightii, and Syringodium filiforme) occurring in adjacent beds within 60 m of each other. Similar suites of epifaunal species occurred on all three seagrass species, with a mean of 82% of the species in common. Relative abundance, however, differed greatly. All of the top 11 species had significant differences in abundance when standardized to: (1) bottom surface area, (2) plant biomass, or (3) plant surface area. Total epifaunal density and gastropod density (per sq m of bottom) were greatest on Halodule, while crustacean density was greatest on Thalassia. However, per plant biomass and especially per plant surface area, crustaceans were by far most abundant on Syringodium, despite Syringodium's low biomass and low surface area-to-biomass ratio. Although considered true in previous studies, neither plant biomass nor plant surface area was a good predictor of patterns of epifaunal abundance. Differential survivorship and active habitat selectivity, in combination with seagrass species composition, are probably also important. (See also W88-10774) (Author's abstract)
W88-10773

MOTILE EPIFAUNA OF MARINE MACROPHYTES IN THE INDIAN RIVER LAGOON, FLORIDA: II. COMPARISONS BETWEEN DRIFT ALGAE AND THREE SPECIES OF SEAGRASSES,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
R. W. Virnstein, and R. K. Howard.
Bulletin of Marine Science BMRSAW, Vol. 41, No. 1, p 13-26, July 1987. 5 fig, 3 tab, 46 ref. Harbor Branch Foundation Contribution No. 560 and S.E.A. Contribution No. 5.

Descriptors: *Macrophytes, *Florida, *Grass, *Algae, *Crustaceans, *Gastropods, Ecosystems, *Lagoons, Seagrass, Aquatic ecosystems, Epifauna, Indian River, Aquatic vegetation, Biomass, Comparison studies.

Within each of three adjacent monospecific beds of seagrasses (Halodule wrightii, Syringodium filiforme and Thalassia testudinum) in the Indian River lagoon, Florida, the motile epifauna of seagrass and drift algae (Gracilaria sp.) were quantitatively sampled. In spite of sometimes large and significant differences in abundance of many epifaunal species, the lists of species on all substrata were similar, with an average of 75% of 47 species (mostly gastropods and preacarid crustaceans) in common. Similarity analysis grouped fauna by substratum type (either algae or seagrass) rather than by site. At each site, the majority of the top 15 species had significant differences in abundance between seagrass and algae, both in terms of individuals per unit biomass and per unit plant surface area. Gastropod species were usually significantly more abundant on seagrass than on algae, whereas crustaceans were more abundant on algae. Both plant biomass and plant surface area were poor predictors of epifaunal abundances across substratum types, contrary to earlier predictions. These strong plant-animal associations may be due to differential survivorship and/or active habitat selection. The former may be particularly important in determining relative abundance of gastropods and crustaceans. When locally abundant, drift algae can be an important component of seagrass systems and may provide superior refuge, food and habitat over seagrasses for associated epifauna. (See also W88-10773) (Author's abstract)
W88-10774

DISTRIBUTION, GROWTH AND MORTALITY OF LARVAL SPOTTED SEATROUT, CYNOSCION NEBULOSUS: A COMPARISON BETWEEN TWO ADJACENT ESTUARINE AREAS OF SOUTHWEST FLORIDA,
University of South Florida, St. Petersburg. Dept. of Marine Science.
E. B. Peebles, and S. G. Tolley.
Bulletin of Marine Science BMRSAW, Vol. 42, No. 3, p 397-410, May 1988. 7 fig, 1 tab, 43 ref.

Descriptors: *Estuaries, *Florida, *Spawning, *Trout, *Temperature effects, *Salinity, Growth rates, Mortality, Distribution, Comparison studies, Fish, Estuarine environment, Larvae.

Distribution, growth and mortality of larval spotted seatrout, Cynoscion nebulosus, were compared between the Naples Bay and Fakahatchee Bay areas of southwestern Florida during the period from July 1983 through January 1985. Back-calculated spawning dates ranged from mid-March through mid-October, with major peaks occurring during the warmer months. Monthly larval densities were positively correlated with water temperature in Naples Bay ($r = 0.35$, $P < 0.01$). Cumulative larval lengths were significantly smaller ($P < 0.001$) in Naples Bay, suggesting a greater proximity of collection stations to spawning locations in this area. Station-specific length distributions indicated that spawning probably occurred in the lower part of Naples Bay and in shallow Gulf of Mexico waters near the Fakahatchee study area. Salinity and temperature are discussed as determinants of spawning activity and larval distribution. A growth rate of approximately 0.4 mm/d was found for both areas. The apparent instantaneous daily mortality coefficient was significantly larger for Naples Bay (0.64 vs. 0.36, $P < 0.001$). (Author's abstract)
W88-10775

REGIONAL VARIATION IN THE CHEMICAL COMPOSITION OF SOIL AND DOMINANT AQUATIC PLANTS IN SHATT AL-ARAB, IRAQ,
Basrah Univ. (Iraq). Dept. of Plant Protection.
For primary bibliographic entry see Field 2E.
W88-10788

STUDIES OF METHANE DYNAMICS IN AN OLIGOTROPHIC LAKE (LAKE STECHLIN) (UNTERSUCHUNGEN DES METHANKEREISLAUFES IN EINEM OLIGOTROPHEN SEE (STECHLINSEE)),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
J. Heyer, and H. Babanzien.
Limnologica LMNOA8, Vol, 16, No. 2, p 267-276, February 1985. 3 fig, 6 tab, 17 ref. English summary.

Descriptors: *Methane, *Oligotrophic lakes, *Methane bacteria, *Chemical properties, *Lake sediments, Sediments, Lakes, Interstitial waters, Microbiology, Biological oxidation, Sediment-water interfaces.

This study concerns the microbiological methane oxidation and methane formation in the oligotrophic Lake Stechlin. High methane formation rates in the littoral sediments (232 - 786 umol CH4/sq m -h) with methane ebullition, high methane concentrations in the interstitial waters of the sediments (91 - 565 umol CH4/L), high numbers of methanotrophic bacteria in littoral (1.6 times 10 to the fourth power to 6.2 times 10 to the fifth power/g) and profundal sediments (8.1 times 10 to the third power to 7.1 times 10 to the fourth power/g) and high activities of these organisms in the aerobic layer of sediments (475 - 961 umol CH4/sq m-h) demonstrate the great ecological importance of the processes of methane cycling in this ecosystem. The comparison of the rates of methane formation and methane oxidation shows, that the methane, which was formed in the deeper layer of sediment, is completely oxidized in the upper layer. Therefore, no methane can penetrate from sediment into water by diffusion and the methane concentrations in water are always very low. Lake Stechlin is an example of an ecosystem in which, because of the uninterrupted presence of oxygen at the surface of sediments, the important processes of methane cycling take place in the sediment only. The main source of the high methane formation in the littoral sediment of this oligotrophic lake is the leaves from the surrounding deciduous wood. (Author's abstract)
W88-10795

PERCENTAGE CONTRIBUTION IN BIOMASS AND MULTIVARIATE ANALYSIS IN SOME WETLANDS OF KASHMIR,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geobotanisches Inst.
S. Kaul.
Limnologica LMNOA8, Vol, 16, No. 2, p 297-306, February 1985. 2 fig, 3 tab, 21 ref.

Descriptors: *Wetlands, *Biomass, *Cycling nutrients, *Macrophytes, *Primary productivity, Aquatic productivity, Nutrients, Biological properties, Seasonal variations.

For estimation of percentage contribution of a species in a wetland, its average biomass (above ground biomass (AGB) and below ground biomass (BGM) separately) was converted to percentage of the total maximum biomass obtained in any of five sites situated northwest of Srinagar, India on the national highway. Studies have revealed that macrophytes are the main contributors of carbon fixation. Sites I, II and III are dominated by emergents while IV and V are somewhat ephemeral types, sustaining a very small number of perennial species. Maximum contribution of AGB was in site II having 1445 g/sq m in August. Emergents dominated in the first three sites whereas Trapa natans contributed maximum in IV and V. Maximum total BGB of 1556 g/sq m is obtained in September in site II. BGB percentage values initially decreased for the first three Months from march onwards, with maximum values in September and minimum in May. Species-wise contribution of BGB showed a notable trend by a few species only. By multivariate analysis AGB and BGB could be predicted on the basis of mineral status, soil characteristics and macroclimatic computation. Climatic and soil factors affect the rate of nutrient buildup through their effect on primary productivity. (Author's abstract)
W88-10796

SPATIAL AND TEMPORAL DISTRIBUTION OF SOME INTERESTING DIATOM SPECIES IN THE RIVER WYE SYSTEM, WALES, U.K.,
University Coll., Cardiff (Wales). Dept. of Plant Science.
S. E. Antoine, and K. Benson-Evans.
Limnologica LMNOA8, Vol. 17, No. 1, p 79-86, April 1986.

Descriptors: *Diatoms, *Stream biota, *Population distribution, Biological properties, Ecosystems, Biomass, Aquatic populations, Alkalinity, Chlorides, Minerals, Wye River, Lugg River, Elan River, Ithon River, Spatial distribution, Temporal distribution.

The spatial and temporal distribution of a few interesting diatom species was studied in the River Wye and in three of its major tributaries, the Rivers Elan, Ithon and Lugg (Wales). Cyclotella meneghiniana, Melosira varians and Rhoicosphenia

currata showed a general downstream increase. This increase of the first two centric diatoms was related to an increase in the mesosaprobity of the studied sites. M. varinas is an epilithic form since it was rarely recorded on sediments. The downstream increase in R. currata was related to an increase in the alkalinity, chloride and conductivity values at the downstream sites. R. currata was considered as an alkaliphil, halophil freshwater form. Pinnularia biceps and P. viridis showed a general downstream decrease. The lower mineral content at the upstream sites was the main reason for the increase of the P. biceps species at these sites. P. viridis was reported as a mountain species and this was a possible factor in finding it in higher densities at the upstream sites than at the downstream ones. The higher mineral content of water at the downstream sites seems to favor. Cylindrotheca gracilis was only found at the lower-most sampling site on the River Wye and in the River Lugg. The increase of chloride content and conductivity at these two sites, and hence the salinity, may be the factor limiting its spatial distribution in the study area. Didymosphenia geminata was only found in the River Elan and in the River Wye below the confluence of these two rivers. All these diatoms showed an almost similar temporal fluctuation, being found in higher densities during the warmer months than during the other months. The higher temperatures and light intensity and lower flows and current velocities during the warmer period seemed to enhance the growth and expansion of these diatoms. (Author's abstract)
W88-10799

STUDIES ON PHYTOPLANKTON OF THE NILE SYSTEM IN UPPER EGYPT,
Assiut Univ. (Egypt). Dept. of Botany.
A. A. Mohammed, A. M. Ahmed, and Z. A. Ahmed.
Limnologica LMNOA8, Vol. 17, No. 1, p 99-117, April 1986. 11 fig, 4 tab, 48 ref.

Descriptors: *Phytoplankton, *Stream biota, *Nile river, Physicochemical properties, Seasonal variations, Chemical properties, Phosphorus, Nitrogen, Irrigation canals, Fish ponds, Algae, Diatoms, Chlorophyte, Cyanophyta.

Monthly variations in physico-chemical characteristics and in planktonic algae were followed from May 1981 to October 1982 in the River Nile, in an irrigation canal and in a fish pond near Sohag, Upper Egypt. The results concerning the fishpond were sometimes very different from those of the River Nile and of the irrigation canal. The fish pond exhibited relatively lower oxygen contents and higher pH-values as well as higher contents of soluble salts, suspended matter and total organic matter in comparison to those of the other two water habitats. The phosphorus and nitrogen depletion in the Nile water and in the irrigation canal occurred mainly in spring and summer months. In the fish pond, the lowest values of phosphorus could be recorded in early spring and early autumn. However, in the case of nitrogen, the lowest values were in summer. The fish pond exhibited very high algal counts that were generally characterized by the dominance of either blue-green or green algae. Some members of euglenoids and yellow green algae were also recorded. The other two water habitats, the Nile and the irrigation canal, exhibited relatively low algal counts that were generally characterized by the dominance of diatoms. (Author's abstract)
W88-10800

COMMENTS ON THE SAPROBITY INDEX (BEMERKUNGEN UEBER DEN SAPROBITAETSGRAD),
Henkel K.G.a.A., Duesseldorf (Germany, F.R.).
W. Guhl.
Limnologica LMNOA8, Vol. 17, No. 1, p 119-126, April 1986. 1 tab, 25 ref. English summary.

Descriptors: *Water quality, *Saprobity index, *Biological properties, *Surface water, Aquatic populations, Comparison studies, Biomass, Productivity, Aquatic environment.

The saprobity index is the biotic index used most often to characterize the biological quality of surface waters. By encompassing all species of the whole community, it describes at least all types of fresh waters very comprehensively. Two surface waters are biologically different if the saprobity difference (delta S) determined by the same investigator, is larger than 0.2 or larger than 0.5 if determined by different investigators. The quality of the results justifies the effort. (Author's abstract)
W88-10801

DRY MATTER PRODUCTION IN FRESHWATER AND MARSH PLANTS AROUND JAIPUR,
Rajasthan Univ., Jaipur (India). Dept. of Botany.
M. K. Saxena.
Limnologica LMNOA8, Vol. 17, No. 1, p 127-138, April 1986. 5 fig, 4 tab, 37 ref.

Descriptors: *Dry matter, *Productivity, *Biomass, *Aquatic plants, *Marsh plants, Marshes, Primary productivity, Macrophytes, Tropical regions, India.

Dry matter production of submerged, free-floating and emergent macrophytes was studied in various water bodies around Jaipur (India). The maximum standing biomass of the submerged macrophytes ranges from 100-895 g/sq m and 1185-5144 g/sq m among the emergent plants. The rate of daily net production is maximum in Eichlornia crassipes (40.4 g/sq m/day). The net primary production of emergent macrophytes is higher in tropical and subtropical regions than in the temperate regions. (Author's abstract)
W88-10802

STUDY OF SEDIMENTATION PROCESSES IN SLOVAK RESERVOIRS,
Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 2J.
W88-10806

IMPLICATIONS IN RECREATION ON RESERVOIRS,
Vyzkumny Ustav Vodohspodarsky, Prague (Czechoslovakia).
S. Blazkova.
Limnologica LMNOA8, Vol. 17, No. 2, p 223-231, October 1986. 3 fig, 2 tab, 19 ref.

Descriptors: *Reservoirs, *Recreation, *Water quality management, *Human diseases, *Public health, Pathogens, Bacteria, Swimming, Czechoslovakia, Water use.

An attempt has been made to list the main factors playing roles in uses of reservoirs and to show their mutual relationships. Special attention was paid to the problems specific to reservoirs built for other purposes or to multipurpose ones. Reservoir operation impact on recreational possibilities has been studied for the most unfavorable case, i.e., the uniform water demand. Risks of waterborne diseases are discussed on the basis of experience contained in available literature. Data (given literature) on reduction of numbers of bacteria in the water as an indication of possible pathogenic contamination have been processed statistically. Indices for recreation pollution with biogenic elements have been suggested: (1) specific number of people per 1 hectare of reservoir per recreational season, and (2) specific number of people per cu m of water flowing through the reservoir per season. These indices show the favorable influence of large size in a reservoir because of the dilution of pollutants. A summary of results for a sample of Czechoslovak reservoirs is given. (Author's abstract)
W88-10807

POSSIBILITY OF ASSESSING THE TROPHIC POTENTIAL IN ORGANICALLY POLLUTED WATERS,
Ceskoslovenska Akademie Ved, Prague.
For primary bibliographic entry see Field 5D.
W88-10815

INPUT OF DECOMPOSABLE ORGANIC MATTER AND BIOMASS CONCENTRATION IN THE PLANKTON OF RESERVOIRS,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 5B.
W88-10816

PHYTOPLANKTON OF THE ZELIVKA RESERVOIR (CZECHOSLOVAKIA),
Vyzkumnmy Ustav Rybarsky Vodnany (Czechoslovakia).
For primary bibliographic entry see Field 5C.
W88-10817

RELATION OF THE ZOOPLANKTON BIOMASS AND SHARE OF LARGE CLADOCERANS TO THE CONCENTRATION OF TOTAL PHOSPHORUS, CHOROPHYLL-A AND TRANSPARENCY IN HUBNEOV AND VRCHLICE RESERVOIRS,
Ceskoslovenska Akademie Ved, Prague.
For primary bibliographic entry see Field 5C.
W88-10818

FEEDING AND FOOD SELECTION IN DAPHNIA PULICARIA (CRUSTACEA:CLADOCERA),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
P. Kasprazak, V. Vyhnalek, and M. Straskraba.
Limnologica LMNOA8, Vol. 17, No. 2, p 309-323, October 1986. 10 fig, 4 tab, 53 ref.

Descriptors: *Daphnia, *Food chains, Biomass, Aquatic animals, Feeding rates.

Experiments were conducted to investigate feeding and food selection in Daphnia pulicaria. Different size groups of Chlamydomonas geitleri were used as food. The maximum filtration rate of the animals (mean size 2.2 mm) was 1.2 ml/animal-h, the maximum feeding rate 0.0326 cu mm/cu mm-h. The saturation concentration was about 0.028 cu mm/ml. Selective grazing was not observed. 'Small' as well as 'big' cells of Chlamydomonas were ingested proportionally to their frequency in the food suspension. The curve concerning feeding rate and the results on selective grazing indicate that the species in the genus Daphnia have only a very limited possibility for active food selection Passive selection mechanisms play the main role. (Friedmann-PTT)
W88-10819

DEVELOPMENT OF WATER QUALITY IN THE HUSINEC RESERVOIR,
Ceskoslovenska Akademie Ved, Prague. Ustav Krajinne Ekologie.
For primary bibliographic entry see Field 5B.
W88-10820

INFLUENCE OF THE WATERSHED AND FISHSTOCK UPON THE FISH POND BIOCENOSES,
Ceskoslovenska Akademie Ved, Prague. Ustav Krajinne Ekologie.
For primary bibliographic entry see Field 5B.
W88-10821

DYNAMICS OF LAKE MICHIGAN PLANKTON: A MODEL EVALUATION OF NUTRIENT LOADING, COMPETITION, AND PREDATION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, G. A. Lang, and J. F. Kitchell.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 1, p 165-177, January 1988. 8 fig, 4 tab, 89 ref.

Descriptors: *Lake Michigan, *Population dynamics, *Plankton, *Limnology, *Nutrients, *Predation, Zooplankton, Phytoplankton, Food chains, Model studies, Simulation, Daphina, Seasonal vari-

ation, Aquatic animals, Aquatic populations, Blue-green algae, Great Lakes, Ecosystems, Lakes.

Lake Michigan's offshore ecosystem has been altered dramatically during the past decade. Summer zooplankton dominance has changed from calanoid copepods to Daphnia and the substantial contribution of filamentous blue-green algae to summer phytoplankton has been replaced by phytoflagellates. These changes occurred concurrently with reduced P load, P concentration, and abundance of the dominant zooplanktivore, the alewife (Alosa pseudoharengus). In this analysis the authors propose alternative hypotheses of nutrient loading and species interactions as determinants of zooplankton and phytoplankton species composition in the summer epilmnion. We evaluate these hypotheses with a food web model that was calibrated to measurements of the 1980s Lake Michigan plankton composition and algal production, sedimentation, and growth rates and literature estimates of zooplankton secondary production and nutrient excretion. The model simulates the influence of gradients of both P load and alewife abundance on predation - competition interactions. The authors conclude that summer plankton composition in Lake Michigan is controlled largely by predation. The model further predicts a return to a plankton community similar to that ot the 1970s under a scenario of increasing invertebrate predation by a new zooplankton community species for Lake Michigan, The European cladoceran Bythotrephes cederstoemi. (Author's abstract)
W88-10824

DISSOLVED PHOSPHORUS DYNAMICS IN HEADWATER STREAMS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2E.
W88-10825

PARTICULATE PHOSPHORUS DYNAMICS IN HEADWATER STREAMS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2E.
W88-10826

INFLUENCE OF LAKE MORPHOMETRY AND THE RESPONSE OF SUBMERGED MACROPHYTES TO SEDIMENT FERTILIZATION,
McGill Univ., Montreal (Quebec). Dept. of Biology.
C. M. Duarte, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 216-221, February 1988. 4 fig, 1 tab, 24 ref.

Descriptors: *Fertilization, *Lakes, *Lake morphology, *Lake sediments, *Lake morphometry, *Macrophytes, Biomass, Aquatic environment, Aquatic populations, Submerged biomass, Submerged plants, Nutrients, Bottom sediments.

The influence of lake morphometry on the growth of submerged macrophytes in response to sediment fertilization was studied at sites of varying bottom slope (steep to gentle), wave exposure (high to low), and depth (1.0 and 2.5 m) in Lake Memphremagog (Quebec-Vermont). The biomass increases were on average 2.1 times greater for fertilized plants than for the paired controls. The extent of the growth response was greatest at the 1.0-m sites. The smaller response at the 2.5-m sites was further decreased as exposure to waves increased. The smaller response at 2.5 m (depth of maximum biomass) suggests that factors such as light limitation, length of th growing season, and littoral slope, but not sediment nutrient levels, limit submerged biomass there. The importance of the physical factors appears to increase as the biomass increases. 'Overwintering' plants showed greater response to fertilization than those growing from seeds. Overall, the extent of the growth response to sediment fertilization depends on the energy environment (i.e. depth, wave exposure, and slope) of the littoral. The influence of these physical factors explains previous difficulties in finding strong correlations between nutrient levels and the growth of submerged macrophytes. (Author's abstract)
W88-10827

EFFECTS OF ACID PH SHOCK ON PHOSPHATE CONCENTRATIONS AND MICROBIAL PHOSPHATE UPTAKE IN AN ACIDIFYING AND A CIRCUMNEUTRAL LAKE,
Toronto Univ. (Ontario). Div. of Life Sciences.
For primary bibliographic entry see Field 5C.
W88-10831

RESPONSE OF LAKE MICHIGAN BENTHIC ALGAE TO IN SITU ENRICHMENT WITH SI, N, AND P,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
H. J. Carrick, and R. L. Lowe.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 271-279, February 1988. 4 fig, 4 tab, 68 ref.

Descriptors: *Lakes, *Algae, *Enrichment, *Silicon, *Nitrogen, *Phosphorous, *Limiting nutrients, *Benthic flora, Nutrients, Population exposure, Biomass, Great Lakes, Diatoms, Population dynamics, Lake Michigan.

The possibility that benthic algae in the nearshore area of Lake Michigan might be growth limited by Si was tested using nutrient-releasing substrata. Nutrient treatments were Si, N + P, Si + N + P, and controls (CONT) and were sampled after 7, 14, and 31 d of exposure. Addition of Si alone had little stimulatory effect on algal biomass, while enrichment with Si + N + P led to the greatest increase in chlorophyll a, particulate Si, total biovolume, and diatom biovolume after 14 d of incubation ($P < 0.0001$). By day 31, communities on CONT and Si substrata exhibited little change in biomass and remained dominated by diatoms (98% of total biovolume), while algal biomass on both N + P and Si + N + P substrata increased more than eightfold ($P < 0.0001$) and consisted mainly of Stigeoclonium tenue (Chlorophyta) and Schizothrix calcicola (Cyanophyta). These results indicate that benthic diatoms in Lake Michigan are not currently limited by Si, but may become Si-limited following enrichment with N + P. (Author's abstract)
W88-10832

RELATIONSHIPS BETWEEN CONCENTRATIONS OF SEDIMENTARY VARIABLES AND TROPHIC STATE IN FLORIDA LAKES,
Florida State Museum, Gainesville.
M. Brenner, and M. W. Binford.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 294-300, February 1988. 2 tab, 29 ref.

Descriptors: *Lakes, *Trophic level, *Lake sediments, *Florida, Model studies, Organic matter, Carbonates, Carbon, Nitrogen, Phosphorus, Pigments, Statistical analysis.

Midlake Sediment samples from 97 Florida lakes were analyzed for organic matter (weight loss on ignition 550 C), carbonate (weight loss on ignition 550-990 C), total C, N, and P, and pigment (SCDU sub 665) content. The authors used simple correlation and multiple regression to examine relationships between concentrations of selected sediment constituents, or their ratios, and trophic state (Carlson's trophic state index-TSI) of the overlying waters. Simple concentrations of sediment variables are poor predictors of TSI. The best simple correlation relates N per gram of organic matter to TSI-Chl a but explains only 27% of the variance in trophic state. The best multiple regression model incorporates five independent sediment variables and accounts for 43% of the variance in TSI-Chl a. Reasons for the poor relationships include (1) interlake variation in the dilution of organic matter and pigments by allochthonous inorganics, (2) variation among lakes in the diagenesis of surface sediments, (3) differential contributions of insoluble, large particulate, inorganic P, and (4) failure of open-water TSI measures to account for contributions to sediments from littoral and allochthonous sources. (Author's abstract)
W88-10834

DISSOLVE CARBOHYDRATE DISTRIBUTION AND DYNAMICS IN TWO SOUTHEASTERN UNITED STATES RESERVOIRS,
Georgia Univ., Sapelo Island. Marine Inst.
J. J. Alberts, J. W. Bowling, and M. Emmons.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 325-332, February 1988. 4 fig, 2 tab, 39 ref.

Descriptors: *Carbohydrates, *Reservoirs, *Macrophytes, *Dissolved organic matter, Stratification, Ponds, Aquatic flora, Limnology.

Dissolved carbohydrate concentrations were measured in the waters of two South Carolina reservoirs (Pond B and Par Pond) in 1982 and 1983 with attention to the influence of rooted aquatic macrophytes, spatial and temporal variability, and depth. Mean concentrations for all sampling locations were 2.86 +/- 1.01 mg/L in Pond B and 1.72 +/- 1.24 mg/L in Par Pond. There were no consistent spatial or temporal differences within a reservoir, nor were there consistent differences between macrophyte beds and open waters in either impoundment. Dissolved carbohydrate concentrations increased in both reservoirs during the day, reaching maxima in late afternoon, with an accompanying decrease in the dissolved organic carbon (DOC). The dissolved carbohydrates comprised 5.8-20.2% of the DOC in Par Pond and 25.7-42.3% of the DOC in Pond B. In both reservoirs, vertical profiles show the presence of carbohydrates at all depths during aerobic and anaerobic conditions. Midwater concentration maxima were present in Par Pond during periods of holomixis and stratification. The maxima were coincident with an intense pycnocline during periods of stratification; but during holomixis, the maximum was apparently unsupported by physical structure. (Author's abstract)
W88-10835

INFLUENCE OF SEASONAL RIVER DISCHARGE ON SURVIVAL OF JUVENILE ATLANTIC SALMON, SALMO SALAR,
Department of Fisheries and Oceans, St. John's (Newfoundland). Science Branch.
R. J. Gibson, and R. A. Myers.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 344-348, February 1988. 2 fig, 2 tab, 36 ref.

Descriptors: *Stream biota, *Stream discharge, *Salmon, *Juvenile growth stage, Seasonal variations, Fish eggs, Population exposure, Fish populations, Survival.

The effects of winter and summer river discharge on the survival of eggs and underyearlings of Atlantic salmon (Salmo salar) were examined in six rivers of Newfoundland and New Brunswick where stock-recruitment relationships were available. There were positive relationships between either winter discharge or temperature and survival of underyearling salmon for five rivers. For all rivers combined, survival and winter discharge were related ($P < 0.05$). The hypothesis that summer discharge was unrelated to survival could not be rejected. However, there was evidence that summer discharge enhances survival in the Miramichi and Northwest Miramichi rivers of New Brunswick. (Author's abstract)
W88-10836

WATER COLUMN AND SEDIMENT CHARACTERISTICS OF LAKE FRYXELL, TAYLOR VALLEY, ANTARCTICA,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
M. J. F. Lawrence, and C. H. Hendy.
New Zealand Journal of Geology and Geophysics NEZOAY, Vol. 28, No. 3, p 543-552, 1985. 6 fig, 1 tab, 19 ref.

Descriptors: *Limnology, *Water chemistry, *Antarctica, *Lake Fryxell, *Stratification, *Lake sediments, Euphotic zone, Saline water, Lakes,

Sediments, Calcite, Deposition, Carbon dioxide, Ice-water interfaces, Thermal stratification, Chemical stratification, Paleolimnology, Aragonite.

Lake Fryxell is a permanently ice-covered 19 m deep lake in the lower Taylor Valley, Antarctica (75 degrees 35 min S, 163 degrees 35 min E). The lake is thermally and chemically stratified and has a euphotic (aerobic) zone above 9 m depth and an anaerobic (anoxic) zone below. Lake waters are derived from glacial melt into which upward diffusion of brines or redissolved salts from the basin has formed a diffusion cell of about 1000 years age. Lake sediment cores contain five recognized units, three of which are calcareous. The uppermost unit (E) has, at the top of the sediment column, calcite flakes precipitated as a result of biological CO2 fixation in the euphotic zone. The calcite is either deposited as stromatolites, where the lake bed is within the euphotic zone, or from suspension over deeper parts of the lake. Unit D is a varve-like aragonite deposit dated at about 10,000 years BP and was deposited as a result of evaporative concentration of lake waters following the retreat of the Ross Sea I expanded ice sheet from the Taylor Valley. Unit C is transitional between units B and D. Unit B is a calcereous mud of mixed aragonite-calcite mineralogy dated at about 20,000 year BP. This date coincides with the maximum extent of advance of the Ross Ice Sheet up the Taylor Valley, and its associated glacial lake Washburn. Thus, unit B was deposited in a deep lake but in a similar manner, chemically, to that of the present CaCO3-H2O-CO2 system. Unit A is probably an outwash fan of the Ross Sea Ice. (Author's abstract)
W88-10845

CIRCULATION AND SEDIMENTATION IN LAKE BENMORE, NEW ZEALAND,
Department of Scientific and Industrial Research, Wellington (New Zealand). Oceanographic Inst.
R. A. Pickrill, and J. Irwin.
New Zealand Journal of Geology and Geophysics, Vol. 29, No. 1, p 83-97, 1986. 10 fig, 2 tab, 17 ref.

Descriptors: *Limnology, *Silting, *Lake sediments, *New Zealand, *Lake Benmore, *Erosion, *Suspended sediments, *Artificial lakes, Seasonal variation, Catchments, Bottom sediments, Annual cycle, Surface water, Shores, Circulation.

Benmore is the largest artificial lake in New Zealand. The lake has two arms, with quite different inflows in terms of volume, temperature, and suspended particulate matter (SPM) loadings. The Ahuriri Arm is fed by natural runoff from unglaciated catchments, whereas the Waitaki Arm receives the outflow of three large glacial-fed lakes which filter out much of the SPM and restrict the temperature range of water entering Lake Benmore. Geographical isolation of the two arms allows each to develop its own annual cycle of lake/river interactions. The Ahuriri water, which is more responsive to seasonal temperatures changes, underflows the warmer Waitaki water in winter and overflows in summer. Upstream lakes entrap most of the bedload from the upper catchment and much of the coarse silt fraction in the suspended load. Consequently, there has been little delta growth with most of the suspended load being clay, which is swept further down the lake. Since forming in 1965, the shoreline (42%) has been altered by limnic processes, with beaches forming in sands and gravels, steep shores being cliffed, prefill subaerial slope failures being rejuvenated, and bedrock and low slopes left unaffected. However, shoreline erosion has only contributed about 8% of the sediment infilling the lake with more than 85% originating from river-borne SPM. Sedimentation rates (3 mm/yr) are lower than in the natural lakes upstream, and sediment deposition should not create any problems to the efficient running of the power station during its design life. (Author's abstract)
W88-10846

DISCHARGE-TIME METHOD. A NEW TECHNIQUE FOR SAMPLING PLANKTON IN FLUVIAL SYSTEMS, WITH A NOTE ON THE MODIFIED PLANKTON SAMPLING DEVICE,
Garhwal Univ., Srinagar (India). Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W88-10857

LIMNOLOGY OF RIVER COOUM WITH SPECIAL REFERENCE TO SEWAGE AND HEAVY METAL POLLUTION,
Presidency Coll., Madras (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-10858

PROFUNDAL MACROBENTHOS IN A POLLUTED LAKE: DEPTH DISTRIBUTION AND ITS RELATIONSHIP WITH BIOLOGICAL INDICES FOR WATER QUALITY ASSESSMENT,
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
For primary bibliographic entry see Field 5C.
W88-10888

EPILITHIC ALGAL NITROGEN FIXATION, STANDING CROPS AND PRODUCTIVITY IN FIVE RIVERS FLOWING THROUGH THE OILSANDS REGION OF ALBERTA/CANADA,
Alberta Univ., Edmonton. Dept. of Botany.
S. E. D. Charlton, and M. Hickman.
Archiv fuer Hydrobiologie, Supplement 79, No. 2/3, p 109-143, February 1988. 13 fig, 8 tab, 75 ref. Alberta Oil Sands Environment Research Programme Project WS 1.3.4 and National Science and Engineering Research Council Grant NSERC A6364.

Descriptors: *Environmental impact, *Stream biota, *Algae, *Cyanophyta, *Nitrogen fixation, *Oil sands region, Standing crops, Spatial distribution, Temporal distribution, Aquatic productivity, Water currents, Lotic environment, Alberta, Canada.

Spatial and temporal fluctuations in epilithic algal standing crops, productivity and nitrogen fixation in five shallow, brown water rivers (the Muskeg, Steepbank, Hamgingston, Mar Kay, and Ells) in Alberta were examined. The epilithic algae exhibited a bimodal peak of standing crop productivity and nitrogen fixation. Spatially, their distribution was extremely heterogeneous, and influenced particularly by physical factors such as shading and current velocity. Epilithic nitrogen fixation was found to play an important role with respect to adding new nitrogen to the lotic systems, and blue-green algae dominated in all rivers. (Author's abstract)
W88-10889

COMPARATIVE STUDY OF SPECIES COMPOSITION, DENSITY AND SPECIES DIVERSITY OF THE PHYTOPLANKTON IN A NON-POLLUTED AND A SEWAGE RECEIVING FRESHWATER RESERVOIR,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W88-10890

PLANKTIC CYANOPHYTES OF LAKE VOLVI, GREECE,
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalenj Biologie a Ekologie.
F. Hindak, and M. T. Moustaka.
Archiv fuer Hydrobiologie, Supplement 80, No. 1-4, p 497-528, March 1988. 19 fig, 18 ref.

Descriptors: *Lake Volvi, *Greece, *Phytoplankton, *Cyanophyta, *Plant morphology, Lakes, Species composition.

From 1983-1986, 32 species of planktic cyanophytes from Lake Volvi, northern Greece (Hellas) were studied. The majority of the species (21) belong to the order Chroococcales, the others (11) to Oscillatoriales. The most common species of planktic cyanophytes could be designated: Microcystis aeruginosa, Coelosphaerium kuetzingianum, Snowella lacustris, Chrroococcus limneticus, Anabaena cf. mendotae, A. perturbata, A. aphanizomenoides, Aphanizomenon issatschenkoi, Aphanizomenon sp., Lyngbya limnetica, L. circumcreta and Oscillatoria cf. lemmermanni. Variability of significant diagnostic features of the investigated species are described. (Author's abstract)
W88-10892

APHANIZOMENON SP. FROM LAKE TRICHONIS, HELLAS (GREECE): A TAXONOMIC CONSIDERATION IN RELATION TO MORPHOLOGICAL AND ECOLOGICAL PARAMETERS,
Athens Univ. (Greece). Inst of Systematic Botany.
K. Anagnostidis, A. Economou-Amilli, and T. Tafas.
Archiv fuer Hydrobiologie, Supplement 80, No. 1-4, p 529-543, March 1988. 10 fig, 2 tab, 73 ref.

Descriptors: *Limnology, *Phytoplankton, *Cyanophyta, *Lake Trichonis, *Greece, *Taxonomy, Plant morphology, Oligotrophic lakes, Ecology, Aphanizomenon, Lakes.

An interesting species of Aphanizomenon was found dominating among other cyanophytes in plankton of the oligotrophic Lake Trichonis. A study was carried out to determine the Aphanizomenon abundance in the phytoplankton composition, to define morphometric characteristics which might lead to elucidation of its taxonomic position and to draw the species ecological requirements after a correlation with selected environmental factors. After an analysis of the morphological characteristics traditionally used in distinguishing the more relates species A. flos-aquae and A. gracile (especially cell width, bundle formation, association with other phytoplankters, response to nutrients, heterocysts frequency) and the new aspects of an additional consideration of their ecological requirements, some peculiarities were defined in the Aphanizomenon from lake Trichonis urging, at present, its classification as Aphanizomenon sp. The special characteristics of the problematic taxon refer to: (1) its appearance in the form of loose aggregates rather than bundles of trichomes, i.e. a similarity to A. gracile, (2) the variation found in the cell width occupying an intermediate position between A. flos-aquae and A. gracile, (3) the differentiation ascertained in the species association with other phytoplankters and an adoption to environmental conditions different from the conventional of the related taxa (oligotrophic instead of mesotrophic-eutrophic). These characteristics combined with additional morphometric data, lacking at present due to the absence of akinetes in all sampling periods, as well as supplemental findings from other lakes might provide enough elements for a future taxonomic reevaluation of the problematic population and a proper and definite classification under a separate taxon. (Author's abstract)
W88-10893

UNEXPECTED DISAPPEARANCE OF CYANOPHYTE BLOOMS IN PLUSSSEE (NORTH GERMANY),
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
B. Hickel.
Archiv fuer Hydrobiologie, Supplement 80, No. 1-4, p 545-554, March 1988. 3 fig, 1 tab, 31 ref.

Descriptors: *Lakes, *Phytoplankton, *Cyanophyta, *Germany, *Dinoflagellates, *Eutrophic lakes, *Eutrophication, Seasonal variation, Species composition, Phosphorus, Ammonium, Biomass, Water pollution effects.

The seasonal periodicity and species composition of the phytoplankton of Plusssee, north West Germany, showed drastic changes during 1972-85 without external perturbation. Two different periods were distinguished, one (1972-77) with dominance of cyanophytes, and a second one (1978-85) with blooms of dinoflagellates. The disappearance of the blooms of Limnothrix redekei with the accompanying Aphanizomenon gracile led to the development of very different cyanophyte assem-

blages. After a year of transition (1978) when Gomphosphaeria was the most abundant cyanophyte, dominance shifted from L. redekei to Anabaena spp. The disappearance of L. redekei led also to a drastic decrease in cyanophyte and total phytoplankton biomass; the annual mean levels of the Cyanophyta ranged between 2.9-10.4 cu mm/l when L. redekei and A. gracile were present (1972-77) and 0.2-1.0 cu mm/l after its disappearance (1978-85). In association with the floristic change, Secchi disc visibility and phosphorus concentrations in the 0-44 m layer increased while ammonium decreased. The annual collapse of the cyanophyte blooms in summer can be attributed to nutrient depletion; other unidentified factors must be the cause of the long term disappearance of L. redekei commencing in spring 1978. (Author's abstract)
W88-10894

PLANT COMMUNITIES ALONG AN EDAPHIC CONTINUUM IN A CENTRAL FLORIDA WATERSHED,
Florida State Museum, Gainesville.
R. B. Huck.
Florida Scientist FLSCA, Vol. 50, No. 2, p 111-128, Spring 1987. 5 fig, 2 tab, 51 ref.

Descriptors: *Swamps, *Plant populations, *Vegetation, *Soil genesis, *Species diversity, Pine trees, Oak trees, Ash trees, Cypress trees, Maple trees, Shrubs, Prairies, Savannahs, Watersheds, Leaching, Litter, Acid soils.

In the Bull Creek Watershed, Osceola County, Florida, vegetation patterns were analyzed in ecological series along three 2 km-long transects in a 10,522 ha pine floodlands region. The most common vegetation unit was a sclerophyllous palmaceous, ericoid and quercine shrub association with an occasional canopy of Pinus palustris or Quercus geminata. Across the continua, vegetation changed with topography, moisture regimes and soils. Six out of the ten soil orders in the U.S. were found: alfisols, entisols, histosols, inceptisols, mollisols and spodosols. A correlation between soil types and vegetation was evident. Upland oak scrub and sand pine dunes, palmetto prairies and savannahs were found over quartzipsamments, haplohumods and haplaquods. Hypericum-grass sinks, cypress domes and ash-cypress-maple swamp forests were located on medisaprists, glossaqualfs, ochraqualfs and argiaquolls. Excessively drained upland soils were low in nutrients while very poorly drained lowland and soils were high in nutrients. Establishment of Spodosols as the most prevalent soil type with concomitant flushing of bases (minerals containing calcium and magnesium) from uplands to lowlands may have coincided with the establishment of the modern pine flora in 500 BP. The radiation of plant communities, which included the appearance of Gordonia bayheads and Taxodium swamp forests at that time must have been accompanied by the development of new edaphic niches. The shift to modern pine flora may have coincided with the establishment of the Spodosal as the dominant soil, triggering the pattern of leaching and pooling of base nutrients. Acid leaching is self-perpetuating and once established acid soils will select for acid-tolerant species such as pines which in turn will produce acid litter. (Sand-PTT)
W88-10900

BROOD SIZE AND NEONATE WEIGHT OF DAPHNIA MAGNA PRODUCED BY NINE DIETS,
Dow Chemical U.S.A., Midland, MI. Dept. of Environmental Quality.
U. M. Cowgill, D. L. Hopkins, S. L. Applegath, I. T. Takahashi, and S. D. Brooks.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 233-244, 2 fig, 3 tab, 11 ref.

Descriptors: *Aquatic animals, *Immature growth stage, *Daphnia, *Diets, *Nutrition, *Algae, Neonates, Growth, Population dynamics.

Nine diets were studied to determine which would produce the largest mean brood size in Daphnia magna. Two media, one inorganic and one organic, were employed to culture three green algae: Selenastrum capricornutum, Ankistrodesmus convolutus, and Chlamydomonas reinhardtii. In addition to single algal foods, mixtures of algae were also employed. These consisted of S. capricornutum and C. reinhardtii, which were fed varying quantities. A synthetic diet of fish chow and alfalfa served as a control. All algae diets were bacteria-free. Neonates were acclimatized in autoclaved Lake Huron water and reared on one of the nine diets for five weeks. Demographic studies were carried out on the progeny of these acclimatized adults. First broods began to arrive after seven days. Thereafter, every other day, neonates were collected, counted, and weighed. These data presented in this study are based on 49,982 neonates. Daphnia magna consuming algae reared on inorganic medium were less productive than those consuming algae reared on organic medium. The largest mean brood size was obtained from the mixed algal diet reared on the organic medium while the smallest mean brood size was produced by the synthetic diet. Large broods generally consisted of lighter individuals (10.8 micrograms/neonate) than those produced in smaller broods (20 micrograms/neonate). The evolutionary significance of this observation, as well as its effect on chronic life cycle studies, is discussed. (See also W88-10991) (Author's abstract)
W88-11008

CHESAPEAKE BAY MARINE ENVIRONMENTAL ASSESSMENT: MARCH 1986 - AUGUST 1986,
Maryland Univ. Eastern Shore, Princess Anne. Coastal Ecology Research Lab.
T. L. Bashore, and K. L. Kelly.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-224606. Price codes: A04 in paper copy, A01 in microfiche. May 1987. 51 p, 15 fig, 22 tab.

Descriptors: *Chesapeake Bay, *Environmental assessment, *Drought, *Marine environment, Precipitation, Seasonal variation, Temperature, Salinity, Recreation, Maryland, Virginia, Fish, Jellyfish, Bays, Economic aspects, Susquehanna drainage basin.

Unusually dry conditions developed in the southern United States in December 1985 and continued into July 1986 to produce the worst drought in at least 111 years. Because of above normal precipitation in the Susquehanna drainage basin, the Chesapeake Bay was not severely affected. Below-normal rainfall conditions and above-normal air temperatures during the spring 1986 quarter provided favorable conditions for finfish and shellfish harvests. High salinities created conditions that affected the distribution of certain bay species of finfish during the summer of 1986. (Lantz-PTT)
W88-11261

CAMAS CREEK (MEYERS COVE) ANADROMOUS SPECIES HABITAT IMPROVEMENT PLAN,
Salmon National Forest, ID.
For primary bibliographic entry see Field 8I.
W88-11275

ANALYSIS OF ALTERNATIVE FISH TRANSPORTATION STRATEGIES,
For primary bibliographic entry see Field 8I.
W88-11276

METHANE FLUX FROM THE CENTRAL AMAZONIAN FLOODPLAIN,
College of William and Mary, Williamsburg, VA. Dept. of Biology.
K. B. Bartlett, P. M. Crill, D. I. Sebacher, R. C. Harriss, and J. O. Wilson.
Available from the National Technical Information Service, Springfield, VA. 22161, as N87-27338. Price codes: A04 in paper copy, A01 in microfiche. (1987). 50 p, 7 fig, 4 tab, 49 ref, 2 append.

Descriptors: *Methane, *Amazon River, *Flood plains, Aquatic plants, Grass mats, Flooding, Forests.

A total of 186 methane (CH4) measurements from the three primary Amazon flood plain environments of open water lakes, flooded forests, and floating grass mats was made over the period 18 July through 2 September 1985. These data indicate that emissions were lowest over open water lakes, where flux averaged 27 + or - a standard error of 4.7 mg CH4/sq m/d (n=41). Flux from flooded forests and grass mats was significantly higher. Emissions from flooded forests averaged 192 + or - 26.8 mg CH4/sq m/d (n=90), while those from floating grass mats averaged 230 + or - 72.2 mg CH4/sq m/d (n=55). At least three transport processes contribute to tropospheric emissions: ebullition from sediments, diffusion along the concentration gradient from sediment to overlying water to air, and transport through the roots and stems of aquatic plants. Measurements indicate that the first two of these processes are most significant. Diffusive flux from flooded forests averaged 50.5 + or- 11.0 mg CH4/sq m/d, while that from floating mats averaged 43.7 + or - 11.8 mg CH4/sq m/d. Diffusive flux from open waters averaged 8.3 + or - 1.9 mg CH4/sq m/d. Emissions through bubbling were 168 + or - 32.2 (flooded forest), 346 + or - 128 mg CH4/sq m/d (floating grasses), and 17.3 + or - 5.2 (open water). On the average, bubbling makes up 49% of the flux from open water, 54% of that from flooded forests, and 64% of that from floating mats. Measurements are applied to the entire Amazonian floodplain, a region which could supply up to 12% of the estimated global natural sources of methane. (Author's abstract)
W88-11288

2I. Water In Plants

DEVELOPMENT OF FLOATING PEAT AND MACROPHYTE VEGETATION IN A NEWLY CREATED, POLYHUMIC RESERVOIR, WESTERN FINLAND,
Water and Environment District of Vaasa, Vaasa (Finland).
For primary bibliographic entry see Field 2H.
W88-10122

RELATIONS BETWEEN PLANKTIC BLUE-GREEN ALGAL DYNAMICS AND ENVIRONMENTAL FACTORS IN FOUR EUTROPHIC SWEDISH LAKES,
Moi Univ., Eldoret (Kenya). Dept. of Wildlife Management.
For primary bibliographic entry see Field 2H.
W88-10127

FIRST STEPS TO PERIPHYTON,
Agricultural Univ., Wageningen (Netherlands). Dept. of Plant Cytology and Morphology.
For primary bibliographic entry see Field 2H.
W88-10128

FOREST WATER USAGE AND INTERACTIONS WITH NUTRITION OF PINUS RADIATA,
Forestry Commission of New South Wales, Beecroft (Australia).
J. Turner, and M. J. Lambert.
Acta Oecologia, Oecologia Plantarum AOSPDY, Vol. 8, No. 1, January 1987. 1 fig, 2 tab, 22 ref.

Descriptors: *Rainfall, *Interception, *Model studies, *Water use, *Fertilization, *Forest management, Forests, Pine trees, Phosphates, Vegetation effects.

The quantity of incident rainfall intercepted by forest canopy and the quantity potentially available for tree growth are estimated. The extent to which interception is affected by stand parameters, par-

ticularly those altered by fertilization, is also assessed. Rainfall interception studies in Pinus radiata plantations were reviewed and a model was developed to relate the percentage of intercepted rainfall to stand density and annual precipitation. It was estimated from this model that in marginal rainfall areas (where phosphatic fertilizer treatments have greatly stimulated growth), rainfall reaching the forest floor was reduced from 812 mm per annum to 632 mm per annum in an average rainfall year. In the fertilized stand, thinning allowed a further 120 mm per annum to reach the forest floor. It was concluded that studies on the impact of intensive forest management on P. radiata water usage are required. (Author's abstract)
W88-10282

RELATIONSHIP BETWEEN HYDROLOGY AND VEGETATIONAL PATTERN WITHIN THE FLOODPLAIN MARSH OF A SUBTROPICAL, FLORIDA LAKE,
Saint Johns River Water Management District, Palatka, FL. Dept. of Water Resources.
For primary bibliographic entry see Field 2H.
W88-10447

EVALUATION OF EVAPOTRANSPIRATION IN TROPICAL CENTRAL AFRICA,
Department of Water Affairs, Maseru (Lesotho).
For primary bibliographic entry see Field 2D.
W88-10485

RAINFALL PATTERNS AS BACKGROUND TO PLANT PHENOLOGY IN NORTHERN TANZANIA,
Groningen Rijksuniversiteit (Netherlands). Zoologisch Lab.
For primary bibliographic entry see Field 2B.
W88-10512

LIMNOLOGICAL INVESTIGATIONS ON THE AL-LATIFIYAH COMMON CARP (CYPRINUS CARPIO) POND (BAGHDAD-IRAQ): I. ENVIRONMENTAL CONDITIONS AND ZOOPLANKTON ABUNDANCE,
Biological Research Center, Baghdad (Iraq).
For primary bibliographic entry see Field 2H.
W88-10640

WATER POTENTIAL GRADIENTS FOR GAPS AND SLOPES IN A PANAMANIAN TROPICAL MOIST FOREST'S DRY SEASON,
Smithsonian Tropical Research Inst., Balboa (Panama).
For primary bibliographic entry see Field 2G.
W88-10767

2J. Erosion and Sedimentation

PROBABILISTIC ANALYSIS OF POREWATER PREDICTIONS FOR UNSTEADY GROUNDWATER FLOW ON A SLOPING BED,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W88-10092

SOIL CONSERVATION: POLITICS, POLICY AND PLANNING,
Pennsylvania Univ., Philadelphia. Dept. of City and Regional Planning.
F. R. Steiner.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8703278. Ph.D. Dissertation, 1986. 531 p, 14 fig, 22 tab, 203 ref.

Descriptors: *Soil conservation, *Soil erosion, *Erosion control, *Policy making, *Legislation, *Long-term planning, Education, Regulations, Enforcement.

The effectiveness of soil conservation planning is examined and policy proposal are given. Federal legislation is analyzed, federal and regional programs are reviewed, state soil conservation laws and programs are described, and soil conservation institutions are evaluated. Soil erosion and soil conservation programs in the Palouse basin are studied and farmers' attitudes about conservation planning are summarized. A national soil conservation policy is suggested with a goal to reduce all erosion in the country to tolerable levels or T-values. The T-values represent the maximum level of erosion that will permit a high level of crop productivity to be sustained economically and indefinitely. Landowners and county governments should develop plans based on these values to remain eligible for federal and state agricultural benefits. These plans should be coupled with regulations and enforcement provisions to ensure compliance. New education efforts and acquisition of easements on the most highly erodible lands are also suggested. (Cremmins-AEPCO)
W88-10093

FIELD EVIDENCE FOR HYDRAULIC JUMPS IN SUBAQUEOUS SEDIMENT GRAVITY FLOWS,
California Univ., Los Angeles. Dept. of Geography.
F. H. Weirich.
Nature NATUAS, Vol. 332, No. 6165, p 626-629, April 14 1988. 2 fig, 18 ref.

Descriptors: *Turbidity currents, *Fluid mechanics, *Hydraulic jump, *Gravity flow, *Reservoir silting, *Sediment transport, Reservoir operation, Reservoirs, Turbidity, Sediments, Geology, Deposition, Reservoirs.

Despite the significance of subaerial and subaqueous sediment-laden gravity flows as geological and geomorphic agents, understanding of such transport and depositional processes is limited. In particular, there is little known about the mechanisms involved in the conversion of higher-density turbidity currents. To address this issue, a detailed field study of this conversion process was undertaken on flows and their deposits within a reservoir. The results presented provide field evidence indicating the occurrence of hydraulic jumps as a conversion mechanism in such flows, and the deposition of large quantities of sediment in the intermediate down-jump area. The findings are significant both in terms of basic geological processes as well as in applications to problems of reservoir management in areas with high sediment inputs. (Author's abstract)
W88-10159

MARINE DISPERSAL AND DEPOSITION OF YELLOW RIVER SILTS BY GRAVITY-DRIVEN UNDERFLOWS,
Virginia Inst. of Marine Science, Gloucester Point.
L. D. Wright, W. J. Wiseman, B. D. Bornhold, D. B. Prior, and J. N. Suhayda.
Nature NATUAS, Vol. 332, No. 6165, p 629-632, April 14 1988. 4 fig, 12 ref.

Descriptors: *China, *Deltas, *Estuaries, *Underflow, *Turbidity currents, *Sediment transport, *Gravity flow, *Sedimentation, *Deposition, Bohai Gulf, Flooding, Yellow River.

Field measurements of the processes of dispersion of concentrated suspended silts over the active delta front of the Yellow River (China) show that cross-isobath sediment dispersal into the shallow Bohai Gulf is dominated by gravity-driven underflows. These underflows descend the rapidly prograding delta front as hyperpycnal plumes 1-4 m thick. The widespread, dilute plumes observed during the summer flood season deposited most of their sediment and experienced extinction between the 5-m and 10-m depth contours. High-frequency internal waves on the upper interface of the underflows may have contributed to the rapid deceleration. Muds resuspended by an intense autumn storm caused denser, but short-lived, plumes which extended downslope to depths of over 13 m. (Author's abstract)
W88-10160

SEASONAL VARIATIONS OF D/H AND 13C/12C RATIOS OF MICROBIAL METHANE IN SURFACE SEDIMENTS,
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W88-10162

SOURCES OF THE LIPIDS IN THE BOTTOM SEDIMENTS OF AN ENGLISH OLIGO-MESOTROPHIC LAKE,
Bristol Univ. (England). Organic Geochemistry Unit.
For primary bibliographic entry see Field 2H.
W88-10209

DISPERSIVE FORCE BASIS FOR CONCENTRATION PROFILES,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
K. C. Wilson, and F. J. Pugh.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 806-810, July 1988. 2 fig, 6 ref, append.

Descriptors: *Sediment-water interfaces, *Dispersive force, *Sediment transport, *Sediment concentration, *Model studies, *Sediment distribution, *Suspended sediments, Bed load, Solids, Bottom sediments.

This paper presents the dispersive-force basis for calculating sediment concentration distribution for both large and small particles, linking bed-load and suspended-load components of solids transport, providing a basis for improved sediment modeling. (Friedmann-PTT)
W88-10235

OBSERVATIONS OF THE CONNECTION BETWEEN WATER MOVEMENTS AND DEEP-BOTTOM SEDIMENTS IN LAKE VANAJANSELKA,
Helsinki Univ. (Finland). Dept. of Geophysics.
For primary bibliographic entry see Field 2H.
W88-10289

WATER CURRENTS AND EROSION OF CELLULOSE FIBERS IN A SHORT TERM REGULATED WATER COURSE,
National Board of Waters, Helsinki (Finland). Water Research Inst.
T. Huttula, and K. Krogerus.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 167-180, 1987. 9 fig, 5 tab, 17 ref.

Descriptors: *Water currents, *Lakes, *Erosion, *Regulated flow, *Sediment transport, *Sedimentation, *Effluents, Hydroelectric plants, Lake Karjenniemenselka, Finland, Cellulose fibers, Sedimentation traps, Valkeakoski River, Shear, Viscose wastes, Pulp wastes.

The interaction between water currents and sedimented effluents from pulp, paper and viscose mills has been investigated with the help of field and laboratory flume measurements. Field measurements were done in Valkeakoski River in southern Finland for 18 days in autumn 1983 with automatic current meters, sedimentation traps and water samples. Water currents were caused by the discharge of a hydropower plant and winds. During four days, 166 tons of suspended solids eroded (of which 160 tons settled again on the area between hydropower plant and Pikkuvuolle and Isovuolle Sounds). Eighty-two percent of the outflowing suspended solids flowed through Isovuolle. The areal distribution of the settling on Lake Karjenniemenselka was determined by throughflow and wind induced currents. The erosion of the sediment taken from the recipient was studied in the flume at various bottom shears. Settling velocity for the sediment was 0.8 m/h. The dependency of the erosion on the bottom shear is presented graphically. The earlier velocity fields also affect the erosion. The critical shear was 0.008 N/sq m. From the field measurements, it was possible to verify that this value is realistic. The relation pre-

sented here may be used in water quality models for erosion of such a sediment. (Author's abstract)
W88-10302

SURFACE RUN-OFF POLLUTION OF AGRICULTURAL BASINS IN THE PROTECTIVE ZONE OF THE DOBCZYCE DAM RESERVOIR (THE CARPATHIAN PLATEAU--POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10362

SOIL AND WATER LOSSES IN A LOW INTENSITY RAINFALL REGION IN IRAQ,
Agriculture and Water Resources Research Centre, Baghdad (Irag).
For primary bibliographic entry see Field 2B.
W88-10400

SEDIMENT, PHOSPHORUS, AND NITROGEN IN CHANNELISED SURFACE RUN-OFF FROM A NEW ZEALAND PASTORAL CATCHMENT,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5B.
W88-10441

HAND-HELD BENTHIC CORE SAMPLER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 7B.
W88-10454

EXPERIMENTAL STUDY OF MERCURY TRANSFER BETWEEN ARTIFICIALLY CONTAMINATED SEDIMENT (CH3HGCL) AND MACROPHYTES (ELODEA DENSA),
Bordeaux-1 Univ., Talence (France). Lab. d'Ecologie Fondamentale et d'Ecotoxicologie.
For primary bibliographic entry see Field 5B.
W88-10504

GEOCHEMICAL MASS-BALANCE RELATIONSHIPS FOR SELECTED IONS IN PRECIPITATION AND STREAM WATER, CATOCTIN MOUNTAINS, MARYLAND,
Geological Survey, Towson, MD.
For primary bibliographic entry see Field 5B.
W88-10518

SEDIMENT DISPERSAL IN THE KNYSNA ESTUARY: ENVIRONMENTAL MANAGEMENT CONSIDERATIONS,
Port Elizabeth Univ. (South Africa). Dept. of Geology.
J. S. V. Reddering, and K. Esterhuysen.
South-African Journal of Geology, Vol. 90, No. 4, p 448-457, December 1987. 7 fig, 20 ref.

Descriptors: *Knysna Estuary, *Erosion, *Sediment sources, *Estuaries, *Sediment distribution, Environmental policy, Dunes, Sand, South Africa, Young Rivers.

The Knysna estuary lies in the southern Cape (South Africa) where its catchment basin drains a small forested area. The estuary is in a youthful stage of development and has a large surface area. It is 17 km long and a permanent, rock-bound tidal inlet connects the estuary with the sea. A low influx of sediment, consisting mainly of sand, enters the estuary. The little mud present is superficial and concentrated in areas near local source rocks of mud, and in areas where restrictions to free flow result in near-stagnant water. The content of skeletal CaCO3 in the sediment gradually decreases up-estuary from the inlet whereas the content of organic material increases up-estuary. Sediment in the estuary has 3 source areas: (i) the sea from where it enters through the inlet; (ii) the catchment basin; and (iii) Brenton dune on the southern bank of the estuary. The dominant sediment source is Brenton dune. If erosion of the partly consolidated sand on the dune were to accelerate it would cause large volumes of sand to be deposited in the estuary; this would lead to undesirable shoaling. Future development on Brenton dune and its environs should be designed specifically to prevent harmful erosion. (Author's abstract)
W88-10563

EFFECTS OF RIVER FLOODS ON SEDIMENT DISPERSAL IN SMALL ESTUARIES: A CASE STUDY FROM EAST LONDON,
Port Elizabeth Univ. (South Africa). Dept. of Geology.
J. S. V. Reddering, and K. Esterhuysen.
South-African Journal of Geology, Vol. 90, No. 4, p 458-470, December 1987. 7 fig, 3 tab, 11 ref.

Descriptors: *Fluvial sediments, *Estuaries, *Erosion, *Sedimentation, Sand, Scour, South Africa, Flood discharge, Intertidal areas, Nahoon Estuary, Gqunube Estuary, Kwelera Estuary.

The Nahoon, Gqunube, and Kwelera estuaries lie on a 15-km stretch of coast northeast of East London. The estuaries have many similarities. Sedimentation in the estuaries is characterized by accumulation of marine sand in the lower estuaries, and deposition of fluvially derived mud in the middle and upper estuaries. The muddy nature of the sediment in the middle and upper sections of the estuaries causes the channels there to have steep banks whereas intertidal flats prevail in the sandy lower reaches of the estuaries. About 400,000 cu m of sediment was scoured from the Nahoon estuary during a river flood in November 1985. The flood caused differential erosion depending on the nature of the sediment: partly consolidated muddy sediment in the middle estuary was much less eroded than sand which was removed in large volumes from the lower estuary. This difference is attributed to the difference in erosion competence between compact mud and loose sand. In the lower Kwelera estuary a dolerite promonotory extending into the channel deflected the flood water away from the previously existing tidal channel. As a result a new channel was eroded into the unconsolidated bed and a gyre, produced by the flow deflection, superficially scoured the surface of the adjacent intertidal flat. (Author's abstract)
W88-10564

SEDIMENT TRANSPORT IN A CURVED CHANNEL,
For primary bibliographic entry see Field 8B.
W88-10586

ANALYSIS OF ERODIBILITY OF TWO TROPICAL SOILS USING A PROCESS MODEL,
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Sciences.
A. Lo, S. A. El-Swaify, and C. W. Rose.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 3, p 781-784, May/June 1988. 5 fig, 2 tab, 9 ref.

Descriptors: *Soil erosion, *Erosion, *Runoff, Soil physical properties, Model studies, Sedimentology, Rainfall impact, Entrainment, Rainfall simulation.

Field-scale runoff and sediment data obtained by rainfall simulation are conventionally analyzed to derive empirical erodibility such as the K-factor in the universal soil loss equation (USLE). In this study, such data were obtained under standardized rainstorms on two highly weathered tropical soils for Hawaii (Typic Torrox and Hydric Dystrandept). In addition, a simplified version of a physically-based model that embodies the processes of rainfall detachment, runoff detachment (entrainment) and deposition (sedimentation) was used to analyze the same data set. Higher USLE erodibility values corresponded well with higher values for the entrainment efficiency of overland flow. It was concluded that this process-based model can complement the empirical USLE to provide a transferable quantitative understanding of soil susceptibility to erosion. (Author's abstract)
W88-10645

DIMENSIONLESS ANALYTICAL SOLUTIONS FOR DAM-BREACH EROSION,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W88-10765

RAINSTORM-INDUCED EVENT SEDIMENTATION AT THE TIDEWATER FRONT OF A TEMPERATE GLACIER,
Northern Illinois Univ., De Kalb. Dept. of Geology.
E. A. Cowan, R. D. Powell, and N. D. Smith.
Geology GLGYB, Vol. 16, No. 5, p 409-412, May 1988. 6 fig, 17 ref. NSF Grants DPP-8420749/DPP8622364 and DPP-8420807.

Descriptors: *Rainstorms, *Rainfall-runoff relationships, *Sedimentation rates, *Runoff, *Glacial melt, *Fjords, Sedimentation, Tidewater, Glaciers, Brackish water, Alaska, Suspended sediments, Salinity, Temperature.

Runoff from a late summer storm drained rapidly to a subglacial stream of McBride Glacier, southeast Alaska. The stream transported large volumes of sediment that discharged from the glacier's tidewater front directly into fjord water at 40 m depth. Measurements of salinity, temperature, and suspended-sediment concentration indicate that the sediment was transported by interflows within brackish fjord water. Sedimentation rates were exceptionally high (up to five times normal). Laminated fine sand accumulated in proximal sediment traps, and silty mud accumulated in distal traps. The low frequency of large storms late in the melt season indicates that the sedimentary products would be rare but significant marker horizons in temperate glacomarine sequences. (Author's abstract)
W88-10793

CHANNEL FORM AND PROCESSES IN BEDROCK AND ALLUVIAL REACHES OF THE RARITAN RIVER, NEW JERSEY,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Geological Sciences.
G. M. Ashley, W. H. Renwick, and G. H. Haag.
Geology GLGYB, Vol. 16, No. 5, p 436-439, May 1988.

Descriptors: *Alluvial channels, *Raritan River, *River beds, *Geomorphology, *Channel morphology, Channeling, New Jersey, Geohydrology, Channels, Bedrock, Thalweg, Meanders, Sediment distribution.

A 12-km bedrockfloored reach of the Raritan River that separates two gravel-bed reaches, above and below, was examined. The bedrock channel has a patchy veneer of sandy gravel that covers the bed in areas of low slope but elsewhere consists of lateral bars and discrete, two-dimensional gravel bed forms perched on bedrock. Mean B-axes of the 25 largest clasts on the crests of these bed forms range from 10.4 to 13.8 cm. Shear stresses estimated from measured velocity profiles and depth-slope calculations indicate that most clasts on the bed forms are entrained by the bankfull discharge (290 m/s) which is equaled or exceeded about 1% of the time. The thalweg of the 80-m-wide channel is incised about 0.5 to 0.7 m, and it meanders with a wavelength of about 750 m, or approximately 10 times channel width. This thalweg meander wavelength is consistent with reference to drainage area when compared to channel meander wavelengths in other locations within the basin and is similar to that in other rivers of comparable dimensions and discharge. The bedrock-alluvial reach is similar to alluvial channels with reference to meander geometry and sediment distribution. It occupies an intermediate position on a continuum of channels of varying sediment supply in relation to transport capacity, ranging from alluvial channels to those completely formed in bedrock. (Author's abstract)
W88-10794

STUDY OF SEDIMENTATION PROCESSES IN SLOVAK RESERVOIRS,

Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
J. Szolgay, and A. Stancikova.
Limnologica LMNOA8, Vol. 17, No. 2, p 213-221, October 1986. 4 fig, 2 ref.

Descriptors: *Sediment transport, *Lake sediments, *Reservoirs, *Sediment distribution, *Erosion, *Bottom sediments, *Aggradation, *Degradation, On-site data collections, Water quality management, Economic aspects, Catchments, Decision making, Resources management, Agriculture, Hydroelectric plants.

A program aimed at solving problems of erosion, transportation, and deposition of bedload, was focused chiefly on applied observations, particularly the assessment of changes in reservoir geometry. The method of direct measurement of aggradation, sedimentation, and degradation has been used. Comparison of repeated measurements in reservoirs, or single measurements and designed parameters, showed the dynamics of erosion-sedimentation processes within the cascade of reservoirs as well as of individual reservoirs, the mutual behavior of the reservoir and catchment. It was possible to quantify and localize the sedimentation within the reservoir. These data enable a correct decision concerning the urgency and kind of reclamation measures. Many aspects of this approach may also be expressed also with respect to their economy, for instance, the returning of the reservoir storage area for hydropower production, utilization of the excavated material in building industry, agriculture, improvement of water quality, design of plans for excavation works, etc. (Author's abstract)
W88-10806

ERRORS OF DETERMINING MATERIAL LOAD FROM A WATERSHED,
Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 7C.
W88-10810

SEDIMENTATION IN AN EBB-TIDAL DELTA, RANGAUNU HARBOUR, NORTHLAND, NEW ZEALAND,
Department of Scientific and Industrial Research, Wellington (New Zealand). Oceanographic Inst.
R. A. Pickrill.
New Zealand Journal of Geology and Geophysics NEZOAY, Vol. 28, No. 3, p 531-542, 1985. 8 fig, 1 tab, 21 ref.

Descriptors: *Estuaries, *Tides, *Deltas, *Sedimentation, *Rangaunu Harbor, *Sediment transport, *New Zealand, Sand, Storm tides, Deposition, Waves.

Rangaunu Harbor is a shallow estuary drained northward by a dendritic channel system onto an extensive ebb-tidal delta. The inlet trough is lined with lag sediments, over which sand is occasionally transported in ribbons. Most sediment transport is confined to channel-margin megaripple fields moving sand seaward onto the terminal lobe of the delta. Interacting wave and tidal forces direct sediment landward from the lobe in anticlockwise gyres, generating recurved bars and furrows on the delta platform and feeding sediment to Te Puke te Huri Spit around the outer face of the delta. Flood tides and shoaling waves return this sediment to the shorefade and back to the harbor mouth. Flood flow is concentrated in a marginal channel on the eastern side of the delta; wave-reinforced flood flows transport sediment landward in sand ribbons from the floor of Rangaunu Bay into the harbor. The bay floor probably supplies 80% of the sediment for delta growth. Between 1958 and 1979, 7.8 x 10 to the sixth power cu m of sediment was added to the delta, with the most significant changes occurring in areas of well-developed bedforms and high sediment transport. Volumetric gains to the delta have been very large but may include cyclic changes in the sediment budget. (Author's abstract)
W88-10844

WATER COLUMN AND SEDIMENT CHARACTERISTICS OF LAKE FRYXELL, TAYLOR VALLEY, ANTARCTICA,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2H.
W88-10845

CIRCULATION AND SEDIMENTATION IN LAKE BENMORE, NEW ZEALAND,
Department of Scientific and Industrial Research, Wellington (New Zealand). Oceanographic Inst.
For primary bibliographic entry see Field 2H.
W88-10846

BEDLOAD TRANSPORT IN GRAVEL CHANNELS,
McGill Univ., Montreal (Quebec). Dept. of Physical Geography.
M. A. Carson, and G. A. Griffiths.
Journal of Hydrology, New Zealand, Vol. 26, No. 1, 1987. Special Issue. 151 p, 64 fig, 12 tab, 189 ref.

Descriptors: *Bed load, *Sediment transport, *Gravel, *Alluvial channels, Canterbury Plains, New Zealand, Case studies, Channels, Literature review, Rivers.

A review is provided of current knowledge regarding the transport of gravel in alluvial channels. Attention is focused on river channels typical of the Canterbury Plains, South Island, New Zealand in which both bed and banks are composed primarily of gravelly alluvium. This point should be borne in mind in any comparison with rivers in other parts of the world where, not infrequently, a gravel-bed channel is bounded by banks of cohesive sediment. The text deals, in turn, with: threshold conditions for the onset and cessation of gravel movement; identification of different components of gravel bed load; formula for the prediction of rates of gravel transport; case studies of prediction of gravel bed transport capacity; and the relationship between the magnitude of gravel loads and channel behavior, particularly the meandering and braiding characteristics of such channels. The review provides both a critical analysis of the present literature dealing with bedload transport in gravel channels, and an assessment of the relevance (or lack thereof) of current scientific theory and engineering practice to field cases in the Canterbury Plains. While definitive answers cannot yet be provided in many cases, the review seeks to identify correctly the conclusions that do emerge from presently available data, and to indicate research directions necessary to provide a more complete understanding of the behavior of such rivers. (Author's abstract)
W88-11028

FLUVIAL PROCESSES IN DRYLAND RIVERS,
Arizona State Univ., Tempe. Dept. of Geography.
W. L. Graf.
Springer-Verlag, New York. 1988. 346 p.

Descriptors: *Rivers, *Channel morphology, *Sediment transport, *Streamflow, *Fluvial processes, *Geomorphology, *River flow, *Semiarid lands, *Arid lands, Theoretical analysis, Vegetation.

This book is a synthesis of river processes and forms in drylands - the semiarid, arid, and extremely arid portions of the earth's surface. It describes the present understanding of dryland rivers, using a theoretical framework with examples and results of research from many areas of the world. The most important feature of this book is that it represents the first organized review of the knowledge about dryland rivers. The primary purpose of this book is to begin the development of a geographic theory for modern dryland rivers by organizing the generalizations available from previous research into a connected intellectual framework. From this assembly of ideas comes a broad perspective on dryland rivers as manifestations of the interactions of three landscapes: a landscape of energy, a landscape of resistance, and a landscape of geomorphic work. The interactions among these landscapes (or the spatial distributions of relevant physical measures) produce water and sediment processes and resulting landforms. Vegetation and direct human invervention are major modifications to the landscapes that alter the processes and forms. This perspective forms the outline of a general theory and is the outline of this book. (Lantz-PTT)
W88-11030

OVERVIEW OF CONSERVATION TILLAGE,
Purdue Univ., Lafayette, IN.
For primary bibliographic entry see Field 4D.
W88-11068

STEELE BAYOU GRAVITY CONTROL STRUCTURE, VICKSBURG, MISSISSIPPI: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W88-11284

EXPERIMENTAL FLUVIAL GEOMORPHOLOGY,
Colorado State Univ., Fort Collins.
S. A. Schumm, M. P. Mosley, and W. E. Weaver.
John Wiley and Sons, New York. 1987. 413 p.

Descriptors: *Fluvial sediments, *Geomorphology, *Sedimentation, *Channel morphology, River channels, Land forming, Alluvial fans, Catchment areas, Runoff, Sediment transport.

Beginning in 1969, a series of experimental studies of drainage basin evolution and hydrology, river channel and valley morphology and behavior, and alluvial-fan morphology and sedimentology were performed. Some experiments were performed to generate and test hypotheses, and others simply to document the morphology and evolution of model landforms. A major objective of this book is to make the results of experiments more generally available. The emphasis is on landforms, but landforms cannot be isolated from hydrologic and sedimentary processes; therefore, in addition to the chapters on drainage basin hydrology, alluvial fan sedimentology, and placers. The book is organized in three parts, which dealt with the morphology and dynamics of (1) drainage basins, (2) rivers and valleys, and (3) alluvial fans and sedimentary deposits. (Lantz-PTT)
W88-11289

2K. Chemical Processes

NATURALLY-OCCURRING SURFACE-ACTIVE MATERIAL CONCENTRATED AT THE AIR/WATER INTERFACE,
Maryland Univ., College Park. Dept. of Chemistry.
W. R. Barger.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8614198. Ph.D. Dissertation, 1985. 217 p, 30 fig, 16 tab, 203 ref, 3 append.

Descriptors: *Surface water, *Surface tension, *Air-water interfaces, *Water sampling, *Natural waters, Compressibility, Physicochemical properties, Subsurface water, Films, Fluorometry, Chesapeake Bay, Atlantic Ocean.

The physico-chemical behavior of microlayer material was characterized using natural water samples collected from the surface and subsurface of the Chesapeake Bay and the Atlantic Ocean. Emphasis was placed on the properties of the material in natural water that reduce surface tension. Film pressure versus area isotherms and coefficients of compressibility were determined. A two-dimensional gas model was used to describe the molecules of the surface film. Compounds containing primary amino groups were measured in the samples using a fluorometric technique. An automated field instrument for measuring surface tension every three minutes was constructed. Water from a floating pump was fed to a chamber with a surface tension sensor. A microcomputer controlled the

pump and the sensor. Surface-active material with closely similar physical properties was generally found in all locations sampled. (Cremmins-AEPCO)
W88-10091

AQUEOUS SOLUBILITY OF SELECTED BIPHENYL, FURAN, AND DIOXIN CONGENERS,
Utah State Univ., Logan. Div. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-10134

ENRICHED CONCENTRATIONS OF BROMINE, CHLORINE, AND IODINE IN URBAN RAINFALL AS DETERMINED BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS,
Illinois Univ. at Urbana-Champaign. Dept. of Nuclear Engineering.
For primary bibliographic entry see Field 5B.
W88-10136

ATHIAS -- AN INFORMATION SYSTEM FOR ABIOTIC TRANSFORMATIONS OF HALOGENATED HYDROCARBONS IN AQUEOUS SOLUTION,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W88-10137

ESTIMATION OF OCTANOL/WATER PARTITION COEFFICIENTS: EVALUATION OF SIX METHODS FOR HIGHLY HYDROPHOBIC AROMATIC HYDROCARBONS,
Utah State Univ., Logan. Div. of Environmental Engineering.
W. J. Doucette, and A. W. Andren.
Chemosphere CMSHAF, Vol. 17, No. 2, p 345-359, 1988. 6 fig, 4 tab, 32 ref. US Dept. of Commerce Grant NA800-AA-D-00086, Project R/MW-21.

Descriptors: *Hydrocarbons, *Chemical properties, *Organic compounds, Molecular structure, Data evaluations, Mathematical models, Chemical analysis, Experimental data.

Six methods for estimating log K sub ow were evaluated using a set of experimental values for 64 aromatic compounds. All log K sub ow values used in this evaluation were experimentally measured using a generator-column technique. This provided an accurate, self-consistent set of compounds having log K sub ow values ranging from 2.13 to 8.58. The estimation methods examined included two group contribution methods and four correlative methods utilizing molecular weight, HPLC retention time, molecular connectivity index, and total molecular surface area. Results of the evaluations showed that correlative methods, using parameters such as RP-HPLC retention times, molecular connectivity indeces, and total surface areas to predict log K sub ow, were more accurate, but required a set of compounds having accurate log K sub ow values. Because the experimental data used in this study contained compounds with log K sub ow values ranging from 2 to 8.58, the correlative methods were developed and evaluated for compounds having higher log K sub ow values than previously reported. The method utilizing MCIs gave the smallest average error and values were easily calculated from structure alone. TSA gave similar results. While more difficult to compute, TSA values may be more conceptually meaningful. (Friedmann-PTT)
W88-10138

VAPOR-PHASE ADSORPTION OF ALKYLBENZENES AND WATER ON SOILS AND CLAYS,
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W88-10150

ATMOSPHERIC CONTAMINATION WITH POLYCHLORINATED BIPHENYLS IN BELA KRAJINA (YUGOSLAVIA): EMISSIONS FROM INDUSTRIAL PLANT, LANDFILL, AND RIVER AREAS,
Public Health Inst. of Slovenia, Lujubijana (Yugoslavia).
For primary bibliographic entry see Field 5B.
W88-10154

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 4. ATMOSPHERIC HEAVY METAL POLLUTION OF THE BOTTOM OF THE RESERVOIR AT KOZLOWA GORA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10180

RATES OF AMMONIA RELEASE FROM SEDIMENTS BY CHIRONOMID LARVAE,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 2H.
W88-10203

PHOSPHORUS INACTIVATION IN A EUTROPHIC LAKE BY THE DIRECT ADDITION OF FERRIC ALUMINIUM SULPHATE: CHANGES IN PHYTOPLANKTON POPULATIONS,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
For primary bibliographic entry see Field 2H.
W88-10208

SOURCES OF THE LIPIDS IN THE BOTTOM SEDIMENTS OF AN ENGLISH OLIGO-MESOTROPHIC LAKE,
Bristol Univ. (England). Organic Geochemistry Unit.
For primary bibliographic entry see Field 2H.
W88-10209

VARIATION IN THE C:P RATIO OF SUSPENDED AND SETTLING SESTON AND ITS SIGNIFICANCE OF P UPTAKE CALCULATIONS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland). Inst. of Aquatic Sciences.
For primary bibliographic entry see Field 2H.
W88-10214

NUCLEATION OF SULFURIC ACID-WATER AND METHANESULFONIC ACID-WATER SOLUTION PARTICLES: IMPLICATIONS FOR THE ATMOSPHERIC CHEMISTRY OF ORGANOSULFUR SPECIES,
California Inst. of Tech., Pasadena. Dept. of Chemical Engineering.
S. M. Kreidenweis, and J. H. Seinfeld.
Atmospheric Environment ATENBP, Vol. 22, No. 2, p 283-296, February 1988. 14 fig, 2 tab, 40 ref, 2 appen.

Descriptors: *Chemistry of precipitation, *Acid rain, *Sulfur compounds, *Nucleation, *Sulfuric acid, *Aerosols, *Air pollution, Atmospheric water, Model studies, Chemical properties.

Binary nucleation theory is applied to the formation of aqueous sulfuric acid and aqueous methanesulfonic acid particles and the relative rates of aerosol formation in humid atmosphere are compared. An integral model is presented that describes nucleation of solution particles, aerosol growth, and condensable vapor source and depletion rates. To extend this model, the water activities of the ternary solution, sulfuric acid-methanesulfonic acid-water, are estimated, and growth of the nucleated aerosol by incorporation of both types of acid is considered. Predictions of both forms of the model are compared with experimental results for the photo-oxidation of demethylsulfide in humid air. (Author's abstract)
W88-10237

NUMERICAL STUDIES OF ACIDIFICATION PROCESSES WITHIN AND BELOW CLOUDS WITH A FLOW-THROUGH CHEMICAL REACTOR MODEL,
Argonne National Lab., IL. Environmental Research Div.
M. S. Hong, and I. Y. Lee.
Atmospheric Environment ATENBP, Vol. 22, No. 2, p 297-305, February 1988. 11 fig, 9 tab, 15 ref.

Descriptors: *Clounds, *Acid rain, *Atmospheric water, *Chemistry of precipitation, *Air pollution, Model studies, Chemical properties, Simulation, Numberical analysis.

A flow-through chemical reactor model had been exercised to assess the importance of various oxidation reactions and cloud processes on wet removal and redistribution of atmospheric pollutants, and to investigate the effect of in-cloud acidification on precipitation chemistry at the surface. Preliminary results indicate that in-cloud acidification accounts for more than 60% of the wet deposited acids derived from acidification of initial S02, that 42-57% of water-soluble, non-reactive NH3 and HNO3 are removed by wet deposition. The pseudo-first-order conversion rate of SO2 to (SO4)2- ranges from 3 to 25%/h depending on initial and boundary conditions. (Author's abstract)
W88-10238

TIME-TRENDS OF SULFATE AND NITRATE IN PRECIPITATION IN NORWAY (1972-1982),
Bergen Univ. (Norway). Geofysisk Inst.
For primary bibliographic entry see Field 2B.
W88-10239

TREND AND SEASONAL VARIATION OF PRECIPITATION CHEMISTRY DATA IN THE NETHERLANDS,
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 2B.
W88-10240

ACID RAIN IN SOUTHWESTERN CHINA,
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
For primary bibliographic entry see Field 2B.
W88-10241

SOLUBILITY OF SOME NATURAL MINERALS IN ATMOSPHERIC PRECIPITATION,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
R. Sequeira.
Atmospheric Environment ATENBP, Vol. 22, No. 2, p 369-374, February 1988. 3 tab, 20 ref.

Descriptors: *Trace elements, *Minerals, *Weathering, *Chemistry of precipitation, *Solubility, Precipitation, Atmospheric water, Chemical analysis, Trace metals.

Theoretical and experimental data on the aqueous solubility of a number of the so-called 'poorly-soluble' natural minerals are presented. The minerals were so chosen as to represent 10 trace elements measured frequently in atmospheric precipitation. The experimental solubility obtained from standard literature is generally found to be several orders-of-magnitude larger than that based on thermodynamic data. The highly enhanced solubility in the laboratory experiments, in all probability, is due to hydrolysis. On the other hand, the concentration of the trace elements in acid-treated bulk precipitation are, apparently, orders-of-magnitude smaller than the experimental values corresponding to their respective minerals considered. Therefore, such minerals in wet natural precipitation ought to be treated as soluble since their aqueous concentrations would only represent sub-saturated solutions. (Author's abstract)
W88-10242

INFLUENCE OF PRETREATMENT ON THE CAPACITY AND SELECTIVITY OF CLINOPTILOLITE FOR METAL IONS,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5F.
W88-10260

PRODUCTION OF LIPOPHILIC VOLATILE ORGANOHALOGEN MATERIALS DURING LABORATORY CHLORINATION OF SOME WASTE WATER AND POLLUTED RIVER WATER SAMPLES FROM YUGOSLAVIA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5D.
W88-10261

NEUTRALIZING STRATEGIES FOR ACID WATERS: SODIUM AND CALCIUM PRODUCTS GENERATE DIFFERENT ACID NEUTRALIZING CAPACITIES,
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 5G.
W88-10266

CONDITIONS REQUIRED FOR THE PRECIPITATION OF ALUMINIUM IN ACIDIC NATURAL WATERS,
Freshwater Biological Association, Ambleside (England).
E. Tipping, C. Woof, P. B. Walters, and M. Ohnstad.
Water Research WATRAG, Vol. 22, No. 5, p 585-592, May 1988. 7 fig, 4 tab, 20 ref.

Descriptors: *Natural waters, *Chemistry of precipitation, *Acid water, *Aluminum, *Solubility, Temperature effects, Hydrogen ion concentration, Aluminum(oxy)hydroxide, Sulfates, Mathematical equations, Decomposing organic matter.

Laboratory and field studies were carried out to define the conditions necessary for the precipitation of Al in natural waters of pH 4.6. It is concluded that if precipitation does occur it involves the formation of Al(oxy)hydroxide, not aluminosilicates or basic aluminum sulfates. The solubility product of the Al(oxy)hydroxide is highly temperature dependent (delta H = -30.5/kcal). It is also sensitive to concentrations of SO4(--) and, more markedly, humic substances (HS); both of these decrease solubility, HS by more than an order of magnitude at a concentration of approximately 5 mg/L (equivalent to approximately 2.5 mg/L dissolved organic carbon). A semi-empirical equation is proposed that allows the prediction of the effective solubility product at different temperatures and at humic concentrations in the range 0-7 mg/L. Of the 113 natural water samples analyzed, only one was calculated to be oversaturated with respect to Al(oxy)hydroxide. (Author's abstract)
W88-10267

ORGANIC COMPLEXATION OF AL IN ACID WATERS: MODEL-TESTING BY TITRATION OF A STREAMWATER SAMPLE,
Freshwater Biological Association, Ambleside (England).
E. Tipping, and C. A. Backes.
Water Research WATRAG, Vol. 22, No. 5, p 593-595, May 1988. 1 fig, 12 ref.

Descriptors: *Acidic water, *Aluminum, *Complexation, *Model testing, *Decomposing organic matter, *Mathematical models, Physiochemical properties, Hydrogen ion concentration, Titration, Chemical analysis, Titration, Errors, Natural water, Errors.

Two models of Al-humic complexation, one empirical, the other based on the physicochemical properties of humic substances, were tested by comparison of predicted and measured concentrations of organically-complexed Al in a series of solutions obtained by adding acid and/or Al(NO3)3 to aliquots of a natural water sample containing approximately 12 mg/L humic substances. Both models gave reasonable predictions of organic complexation, although each was subject to bias with predicted values being invariably too low at pH 3.5-4 and in most cases too high at approximately pH 5. The bias may arise from analytical difficulties in determining organically complexed Al, and/or from pH-dependent competition for humic binding sites. (Author's abstract)
W88-10268

COMPLEXATION OF PROTONS, ALUMINUM AND CALCIUM BY AQUATIC HUMIC SUBSTANCES: A MODEL INCORPORATING BINDING-SITE HETEROGENEITY AND MACROIONIC EFFECTS,
Freshwater Biological Association, Ambleside (England).
E. Tipping, C. A. Backes, and M. A. Hurley.
Water Research WATRAG, Vol. 22, No. 5, p 597-611, May 1988. 10 fig, 7 tab, 23 ref.

Descriptors: *Acidic water, *Aluminum, *Complexation, *Model studies, *Humic acids, *Mathematical models, *Calcium, Metals, Decomposing organic matter, Ions, Equilibrium, Hydrogen ion concentration, Chemical analysis, Natural waters, Solubility.

A model is presented that describes the competitive binding of protons and metal ions (Al(+++), AlOH(++), Ca(++)) by humic substances (HS) in the pH range 3-6 and at different ionic strengths, and allows the net humic charge to be calculated. The HS are treated in terms of two types of carboxyl group, together with other more weakly-acidic groups, and the influence of humic (macroionic) charge is taken into account. Eight parameters are involved: total humic acidity, which can be measured directly, content of COOH groups, 4 intrinsic equilibrium constants (2 for H+ binding, 2 for metal binding), and 2 parameters accounting for charge effects at different ionic strengths. The model was applied to 4 aquatic humic samples, parameters being estimated from acid-base titration data. The equilibrium contents did not vary greatly among the humic samples, which is consistent with the idea that the functional groups in each sample are chemically the same. The effect of humic charge of complexation varies considerably among the samples. The model was reasonably successful at predicting humic-bound Al in laboratory-prepared solutions and field samples. Calculations based on the model suggest that Ca(++) does not compete significantly with Al for binding to HS under natural acid conditions, and that there is a direct relationship between humic solubility and net humic charge. (Author's abstract)
W88-10269

MECHANISMS OF PRECIPITATION OF MANGANESE(II) IN LAKE BIWA, A FRESH WATER LAKE,
Shiga Univ., Otsu (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W88-10270

WATER CURRENTS AND EROSION OF CELLULOSE FIBERS IN A SHORT TERM REGULATED WATER COURSE,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 2J.
W88-10302

PHOSPHORUS ACCUMULATION IN SEDIMENTS AND INTERNAL LOADING,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 2H.
W88-10359

FORMS OF MINERAL PHOSPHORUS IN THE BOTTOM SEDIMENTS OF THE LUBACHOW RESERVOIR AND LAKE SLAWA (SOUTHWESTERN POLAND),
Wyzsza Szkola Inzynierska, Zielona Gora (Poland).
For primary bibliographic entry see Field 2H.
W88-10373

TRANSPORT OF HEAVY METALS IN THREE DIFFERENTLY POLLUTED SURFACE WATERS IN SILESIA (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10374

HYDROCHEMICAL CHARACTERISTICS OF THE WISLA-CZARNE RESERVOIR (SOUTHERN POLAND) IN THE PERIOD 1975-1984,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 5B.
W88-10375

REMOVAL OF AROMATIC NITRO COMPOUNDS FROM WATER BY OZONATION,
Harbin Civil Engineering Inst. (China). Water Pollution Control Lab.
For primary bibliographic entry see Field 5F.
W88-10381

PRACTICAL DESIGN MODEL FOR CALCULATING BUBBLE DIFFUSER CONTACTOR OZONE TRANSFER EFFICIENCY,
Process Applications, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 5D.
W88-10388

EVOLUTION OF THE CHEMICAL COMPOSITION OF THE GARONNE RIVER WATER DURING THE PERIOD 1971-1984,
Toulouse-3 Univ. (France). Lab. de Mineralogie et Cristallographie.
For primary bibliographic entry see Field 5B.
W88-10399

ALKALINITY IN SURFACE WATER ACIDIFICATION STUDIES: A COMPARISON OF TWO METHODS,
North East River Purification Board, Aberdeen (Scotland).
For primary bibliographic entry see Field 5A.
W88-10404

SIMULATION OF BIODEGRADATION AND SORPTION PROCESSES IN GROUND WATER,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-10421

EFFECTIVENESS OF VARIOUS AQUIFER RESTORATION SCHEMES UNDER VARIABLE HYDROGEOLOGIC CONDITIONS,
H and A of New York, Rochester.
For primary bibliographic entry see Field 5G.
W88-10422

TRILINEAR DIAGRAM REVISITED: APPLICATION, LIMITATION, AND AN ELECTRONIC SPREADSHEET PROGRAM,
Arizona Univ., Tucson. Dept. of Geosciences.
For primary bibliographic entry see Field 7C.
W88-10424

ASSESSMENT OF A SIMPLE SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF DISSOLVED ORGANIC CARBON IN FRESHWATERS,
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-10440

LIMNOLOGICAL CHARACTERISTICS OF SANGRE ISLE LAKE, OKLAHOMA (U.S.A.),
Oklahoma State Univ., Stillwater. Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W88-10452

DIEL AND SEASONAL CHANGES OF DISSOLVED OXYGEN AND PH IN RELATION TO COMMUNITY METABOLISM OF A SHALLOW RESERVOIR IN SOUTHEAST MISSOURI,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W88-10457

BUDGET AND INPUT-OUTPUT MODEL FOR TOTAL PHOSPHORUS IN LAKE LEMAN (BILAN ET MODELE D'ENTREES - SORTIES DU PHOSPHORE TOTAL DANS LE LEMAN),
Geneva Univ. (Switzerland). Unite de Biologie Aquatique.
For primary bibliographic entry see Field 5B.
W88-10468

SEDIMENT-WATER EXCHANGE OF PHOSPHORUS. THE INFLUENCE OF SEDIMENT DILUTION ON RADIOTRACER KINETICS (ECHANGES DE PHOSPHORE ENTR LES SEDIMENTS ET L'EAU. INFLUENCE DE LA DILUTION SUR LES CINETIQUES DE TRACAGE ISOTOPIQUE),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 7B.
W88-10480

EVALUATION OF THE USE OF CATION-EXCHANGE RESIN FOR THE DETERMINATION OF ORGANICALLY-COMPLEXED AL IN NATURAL ACID WATERS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 7B.
W88-10522

APPLICATION OF A PORTABLE ION CHROMATOGRAPH FOR FIELD SITE MEASUREMENTS OF THE IONIC COMPOSITION OF FOG WATER AND ATMOSPHERIC AEROSOLS,
Technische Univ., Vienna (Austria). Inst. fuer Analytische Chemie.
For primary bibliographic entry see Field 5A.
W88-10529

UNSUBSTITUTED AND HYDROXY SUBSTITUTED FATTY ACIDS IN A RECENT LACUSTRINE SEDIMENT (LAKE LEMAN, GENEVA, SWITZERLAND),
Geneva Univ. (Switzerland). Mass Spectrometry Center.
For primary bibliographic entry see Field 2H.
W88-10532

DETERMINATION OF ALKALINE EARTH METALS IN JAPANESE RAIN AND SNOW BY ICP EMISSION SPECTROMETRY,
Meteorological Research Inst., Yatabe (Japan).
Y. Dokiya, M. Aoyama, and Y. Katsuragi.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 32, No. 2, p 145-165, January 1988. 7 fig, 4 tab, 4 ref.

Descriptors: *Emission spectroscopy, *Chemical analysis, *Rain, *Snow, *Alkaline earth metals, *Saline water, Japan, Magnesium, Barium, Strontium, Calcium.

Alkaline earth metals (magnesium, calcium, strontium and barium) were easily determined in rain and snow samples by sequential inductively coupled plasma (ICP) emission spectrometry, when appropriate instrumental conditions and solution matrices were chosen. In this study, 1 N HNO3 solution was used, without any preconcentration or separation, in a regular determination mode by a sequential ICP emission spectrophotometer. The amount of monthly deposition of magnesium, calcium, strontium and barium was determined at 11 stations in Japan in 1984 and 1985. The seasonal variation of Sr(excess) served as a good index for the characterization of Japanese rain and evaluating the contribution rate of sea salt. (Author's abstract)
W88-10543

PURGE AND TRAP GAS CHROMATOGRAPHIC METHOD FOR DIMETHYL SULFIDE IN FRESHWATER,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 7B.
W88-10545

DEPOSITION OF MERCURIC CHLORIDE ON THE SURFACE OF WATERS,
Service Cantonal d'Ecotoxicologie, Geneva (Switzerland).
For primary bibliographic entry see Field 5B.
W88-10547

SEASONAL CHANGE OF STREAMWATER CHEMISTRY IN TSUKUBA EXPERIMENTAL FORESTED LAND,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
T. Hirata, and K. Muraoka.
Japanese Journal of Limnology RIZAA, Vol. 49. No. 1, p 1-9, January 1988. 8 fig, 14 ref.

Descriptors: *Streams, *Forest hydrology, *Water chemistry, *Seasonal variation, *Rainfall-runoff relationships, *Solute transport, Ions, Nutrients, Rainfall, Runoff, Streams, Forests, Japan, Tsukuba Experimental Forest.

This paper describes the seasonal changes of the stream solute concentration for two years in the Tsukuba Experimental Forest with 67.5 ha. NO3(-)-N concentration shows the clear seasonal change according to which it is elevated in summer, but declines in winter. Runoffs of K(+) and Ca(2+) seem to have a pattern similar to NO3(-)-N behavior. On the other hand, SiO2 concentration declines occasionally due to the effect of the rainfall runoff, as does Na(+) concentration. Two types of runoff can be found in time-dependent changes of the stream solute concentration during the rainfall runoff event. Most of the solute concentrations decrease in the rising limb, and increase in the recession limb. In the end stage of the recession limb, the solute concentration classified into Type I recovers approximately the baseflow level prior to the rainfall runoff, while that classified into Type II overshoots the baseflow level. SiO2 and Na(+) belong to Type I, and NO3(-)-N, K(+) and Ca2(+) to Type II. This proves that (1) concentration of Type I remains lowered due to the effect of the rainfall runoff, compared to the baseflow level, and (2) when a new rainfall runoff event occurs, concentration of Type II is raised still more than the older one. Thus, there is a concentration increase of NO3(-)-N in summer due to successive rainfall. These runoff features are reliable for interpreting the seasonal changes mentioned above. (Author's abstract)
W88-10571

COPPER (II) COMPLEXING CAPACITY OF LAKE HARUNA WATER, (IN JAPANESE),
Gunma Inst. of Public Health (Japan).
For primary bibliographic entry see Field 2H.
W88-10573

PRELIMINARY STUDY ON N2O PRODUCTION THROUGH NITRIFICATION IN LAKE KIZAKI,
Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 2H.
W88-10575

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VIII. ZOOSYRTHON IN THE TRIBUTARIES AND OUTLET OF LAKE JORZEC,
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
For primary bibliographic entry see Field 2H.
W88-10597

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): IX. THE EXCHANGE OF PHOSPHORUS BETWEEN SEDIMENTS AND WATER,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W88-10598

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): X. ROLE OF THE MUSSEL DREISSENA POLYMORPHA (PALL.) IN N AND P CYCLES IN A LAKE ECOSYSTEM,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W88-10599

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): XI. NUTRIENT BUDGET WITH SPECIAL CONSIDERATION TO PHOSPHORUS RETENTION,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W88-10600

COLLOIDAL AND DISSOLVED ORGANIC CARBON DYNAMICS IN UNDISTURBED BOREAL FOREST CATCHMENTS: A SEASONAL STUDY OF APPARENT MOLECULAR WEIGHT SPECTRA,
University Coll. of North Wales, Bangor. School of Animal Biology.
For primary bibliographic entry see Field 2H.
W88-10653

FLUXES OF FREE AMINO ACIDS IN THREE DANISH LAKES,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 2H.
W88-10657

DOES IONIC STRENGTH AFFECT THE CONFIGURATION OF AQUATIC HUMIC SUBSTANCES, AS INDICATED BY GEL FILTRATION,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 7B.
W88-10661

INEXPENSIVE WATER CIRCULATION SYSTEM FOR STUDIES OF CHEMICAL EXCHANGE USING SEDIMENT CORES,
Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
For primary bibliographic entry see Field 7B.
W88-10662

OCCURRENCE OF PHOSPHORUS AND ITS POTENTIAL REMOBILIZATION IN THE LITTORAL SEDIMENTS OF A PRODUCTIVE ENGLISH LAKE,
Vermont Univ., Burlington. Dept. of Geology.
For primary bibliographic entry see Field 2H.
W88-10663

DISSOLVED ORGANIC CARBON, SESTON AND MACROINVERTEBRATE DRIFT IN AN ACIDIFIED AND LIMED HUMIC STREAM,
Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 5G.
W88-10666

PHOSPHORUS TRANSFORMATIONS IN THE EPILIMNION OF HUMIC LAKES: ABIOTIC

INTERACTIONS BETWEEN DISSOLVED HUMIC MATERIALS AND PHOSPHATE,
Loughborough Univ. of Technology (England). Dept. of Human Sciences.
For primary bibliographic entry see Field 2H.
W88-10670

DISSOLVED ORGANIC MATTER IN CUMBRIAN LAKES AND STREAMS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W88-10671

IN VITRO STUDIES ON SULFATE REDUCTION AND ACIDIFICATION IN SEDIMENTS OF SHALLOW SOFT WATER LAKES,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5B.
W88-10674

THERMAL AND CHEMICAL STRATIFICATION AND MIXING IN A SMALL TROPICAL RESERVOIR, SOLOMON DAM, AUSTRALIA,
James Cook Univ. of North Queensland, Townsville (Australia).
For primary bibliographic entry see Field 2H.
W88-10681

SPATIAL VARIATIONS IN AND CONTROLS ON THE CALCITE SATURATION INDEX IN ACTON LAKE, OHIO,
Miami Univ., Oxford, OH. School of Interdisciplinary Studies.
For primary bibliographic entry see Field 2H.
W88-10682

EFFECTS OF VEGETATION REMOVAL BY GRASS CARP AND HERBICIDES ON THE WATER CHEMISTRY OF FOUR FLORIDA LAKES,
Rollins Coll., Winter Park, FL. Dept. of Biology.
For primary bibliographic entry see Field 4A.
W88-10686

GEOCHEMICAL ASPECTS OF AQUEOUS IRON, PHOSPHORUS AND DISSOLVED ORGANIC CARBON IN THE HUMIC LAKE TJEUKEMEER, THE NETHERLANDS,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2H.
W88-10714

SHORT-TERM EXPERIMENTAL ACIDIFICATION OF A WELSH STREAM: COMPARING THE BIOLOGICAL EFFECTS OF HYDROGEN IONS AND ALUMINIUM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5C.
W88-10736

OCCURRENCE AND MECHANISMS OF MICROBIAL OXIDATION OF MANGANESE,
Wisconsin Univ.-Milwaukee. Dept. of Biological Sciences.
K. H. Nealson, B. M. Tebo, and R. A. Rosson.
Advances in Applied Microbiology ADAMAP, Vol. 33, p 279-318, 1988. 13 fig, 5 tab, 86 ref.

Descriptors: *Geochemistry, *Reviews, *Manganese, *Microbial oxidation, *Water chemistry, *Metals, Microorganisms, Microbiological studies, Field tests, Aquatic habitats, Analytical methods, Cycling nutrients, Culturing techniques, Bacteria.

In recent years, much progress has been made in the area of microbial Mn(II) oxidation. New techniques for field studies in aquatic environments have been developed to measure rates of Mn(II) oxidation and to allow the inhibition of biological Mn(II) oxidation without interfering with the chemistry of manganese. Other approaches have been developed for the analysis of Mn(II) oxidation rates in sedimentary environments. The results of these field studies have revealed that, in many environments with well-developed oxic/anoxic interfaces (fjords, lakes, and sediments), microbial Mn(II) oxidation is an important catalytic factor markedly affecting the kinetics of metal removal. When taken together, the laboratory and field data make a very strong case for the importance of microbes in the regulation of manganese chemistry in many environments. During the past decade, the very preliminary laboratory data that were available had an immense impact on the field work that was done - field work that has unequivocably shown the importance of bacterial catalysis of Mn(II) oxidation. (Alexander-PTT)
W88-10742

STUDIES OF METHANE DYNAMICS IN AN OLIGOTROPHIC LAKE (LAKE STECHLIN) (UNTERSUCHUNGEN DES METHANKREISLAUFES IN EINEM OLIGOTROPHEN SEE (STECHLINSEE)),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
For primary bibliographic entry see Field 2H.
W88-10795

LONG-TERM TRENDS IN WATER CHEMISTRY OF THE VLTAVA RIVER (CZECHOSLOVAKIA),
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 5B.
W88-10813

DISSOLVE CARBOHYDRATE DISTRIBUTION AND DYNAMICS IN TWO SOUTHEASTERN UNITED STATES RESERVOIRS,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2H.
W88-10835

WATER COLUMN AND SEDIMENT CHARACTERISTICS OF LAKE FRYXELL, TAYLOR VALLEY, ANTARCTICA,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2H.
W88-10845

UPTAKE AND RELEASE OF MATERIALS BY A WADDEN SEA MUSSEL BED,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 2L.
W88-10869

GEOCHEMISTRY OF INTERSTITIAL WATER FOR A SEDIMENT CORE FROM THE INDIAN RIVER LAGOON, FLORIDA,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 5C.
W88-10899

DEVELOPMENT AND APPLICATION OF A COUPLED GEOHYDROCHEMICAL CODE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-10916

SIMULATION WITH A COMPLEXATION-ADSORPTION MODEL OF POSSIBLE EFFECTS OF DISSOLVED HUMIC SUBSTANCES ON SOLUTE TRANSPORT IN SOILS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W88-10917

EXTENSION OF GEOCHEMICAL MODELLING TECHNIQUES TO BRINES: COUPLING OF THE PITZER EQUATIONS TO PHREEQE,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W88-10919

GEOCHEMICAL REACTION MODELING IN CONTAMINANT MIGRATION STUDIES OF THE URANIUM MILL TAILINGS ENVIRONMENT,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-10980

CHEMISTRY OF GROUND WATERS IN THE CENTRAL FLORIDA PHOSPHATE DISTRICT,
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-11098

HYDROGEOCHEMICAL ANALYSIS OF COLD CREEK AND BLAYNE SPRING, ENNIS, MONTANA,
Greiner Engineering Sciences, Inc., Tampa, FL.
For primary bibliographic entry see Field 2E.
W88-11133

2L. Estuaries

MARINE DISPERSAL AND DEPOSITION OF YELLOW RIVER SILTS BY GRAVITY-DRIVEN UNDERFLOWS,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2J.
W88-10160

SEASONAL VARIATIONS OF D/H AND 13C/12C RATIOS OF MICROBIAL METHANE IN SURFACE SEDIMENTS,
University of South Florida, St. Petersburg. Dept. of Marine Science.
R. A. Burke, C. S. Martens, and W. M. Sackett.
Nature NATUAS, Vol. 332, No. 6167, p 829-831, April 28 1988. 2 fig, 1 tab, 28 ref.

Descriptors: *Seasonal variation, *Wetlands, *Coastal waters, *Carbon cycle, *Isotope studies, *Methane, *Sediments, *Marine sediments, Cape Lookout Bight, North Carolina.

Application of stable isotope ratios (delta D and delta 13 C) to the study of the global CH4 cycles requires isotopic characterization of chief atmospheric CH4 sources. Shallow aquatic sediments have been postulated to be an important CH4 source. However, the stable isotope composition of CH4 produced in these systems is not well defined. Further, the relative importance of the various processes that influence CH4 delta values is not generally predictable and probably varies from site to site. This study found appreciable seasonal and spatial (probably depth-dependent) variation in the delta D and delta C of gas-phase microbial CH4 produced in the marine sediment of Cape Lookout Bight (CLB), North Carolina. In light of seasonal and depth-dependent variations of CH4 production from acetate and acetate concentrations in CLB sediments, observations were made that provide indirect evidence that the CLB CH4 delta variation reflects variation in the relative contributions of the main CH4 precursors (acetate and CO2/H2). Delta D-CH4 and Delta 13C-CH4 are inversely correlated, indicating that microbial consumption is not responsible for the delta variation. Owing to its marine nature, CLB is not strictly representative of wetlands in general. However, some of the key microbial processes and environmental characteristics that appear largely responsible for the observed CLB CH4 delta variation are probably similar in typical temperate and high-latitude wetlands. (Author's abstract)
W88-10162

DISPERSAL OF THE AMAZON'S WATER,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
F. E. Muller-Karger, C. R. McClain, and P. R.

Richardson.
Nature NATUAS, Vol. 333, No. 6168, p 56-59, May 5 1988. 3 fig, 26 ref.

Descriptors: *Ocean circulation, *Amazon River, *River flow, *Water currents, *Seasonal variation, Buoys, Coastal zone color scanner, North Equatorial Countercurrent, North Brazil Current, Carribean Sea, Atlantic Ocean, Africa, Remote sensing, South America.

The Amazon is the largest river system in the world, contributing about 6 times 10 to the 12th power cu m of fresh water to the tropical Atlantic each year. The fate of this water, and of the dissolved and particulate material discharged with it, has remained unclear. Previous observations of 300-km diameter lenses of Amazon water off South America and a plume that extends into the Atlantic indicate some offshore movement. But the relationship of these and along-shore currents has remained obscure. New information, obtained with NASA's Coastal Zone Color Scanner and with drifting buoys, reveals that the discharge of the Amazon is carried offshore around a retroflection of the North Brazil Current and into the North Equatorial Countercurrent towards Africa between June and January each year. From about February to May, the countercurrent and the retroflection weaken or vanish, and the Amazon water flows northwestward towards the Caribbean Sea. (Author's abstract)
W88-10163

CONCENTRATIONS OF CADMIUM AND OTHER METALS IN FUCUS VESICULOSUS L. AND FONTINALIS DALECARLICA BR. EUR. FROM THE NORTHERN BALTIC SEA AND THE SOUTHERN BOTHNIAN SEA,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
For primary bibliographic entry see Field 5B.
W88-10196

HYDROCARBONS IDENTIFICATION IN 'HUIRO' (MACROCYSTIS PYRIFERA) FROM THE STRAIT OF MAGELLAN (IDENTIFICACION DE HIDROCARBUROS EN HUIRO (MACROCYSTIS PYRIFERA) DEL ESTRECHO DE MAGALLANES),
Universidad de Magallanes, Punta Arenas (Chile). Inst. de la Patagonia.
For primary bibliographic entry see Field 5A.
W88-10201

PEAT AND PEAT WATER CHEMISTRY OF A FLOOD-PLAIN FEN IN BROADLAND, NORFOLK, U.K.,
Sheffield Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W88-10205

VARIATION IN PARAGNATH NUMBER OF NEREIS DIVERSICOLOR IN THE BOU REGREG ESTUARY (MOROCCO) (VARIATIONS DE LA DISTRIBUTION DES PARAGNATHES CHEZ NEREIS DIVERSICOLOR DANS L'ESTUAIRE DU BOU REGREG (MAROC)),
Laboratoire de Zoologie et d'Ecologie Marine, Angers (France).
P. Gillet.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 4, p 481-490, 1986. 4 fig, 3 tab, 12 ref (English summary).

Descriptors: *Species composition, *Anatomy, *Annelids, *Polychaetes, *Paragnathes, *Estuarine environment, Salinity, Particle size, Sediments, Bou Regreg Estuary, Morocco, Estuaries.

Variation in paragnath number of Nereis diversicolor from the Bou Regreg estuary (Morocco) has been investigated in relation to salinity and sediment type. Mean numbers of paragnaths increase from the mouth of the estuary to upstream, in an inverse relationship to salinity. These variations could also be attributed to ecological factors, especially to the median particle size of the sediment. Individuals living in areas where the substrate is a coarser sand have a larger number of paragnathes. (Author's abstract)
W88-10216

BENTHIC RECOLONIZATION OF A SEDIMENT IN AN EXPERIMENTAL AREA TRANSPLANTED FROM ITS NATURAL SURROUNDINGS (INFRALITTORAL STAGE OF A MEDITERRANEAN BAY, TOULON, FRANCE), (RECOLONISATION BENTHIQUE D'UN SEDIMENT DANS DES ENCEINTES EXPERIMENTALES REPLACEES DANS LE MILIEU NATUREL (ETAGE INFRALITTORAL D'UNE BAIE MEDITERRANEENNE)),
Lille-1 Univ., Wimereux (France). Wimereux Marine Station.
For primary bibliographic entry see Field 5C.
W88-10217

SOLUBILITY OF SOME NATURAL MINERALS IN ATMOSPHERIC PRECIPITATION,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
For primary bibliographic entry see Field 2K.
W88-10242

FAUNISTIC AND COENOTIC STUDY OF THE ANNDID FAUNA OF THE ALBUFEIRA AND OBIDOS LAGOONS (PORTUGAL) (ETUDE FAUNISTIQUE ET COENOTIQUE DE LA FAUNE ANNELIDIENNE DES LAGUNES D'ALBUFEIRA ET OBIDOS (PORTUGAL)),
Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal).
V. Quintino, and F. Gentil.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 1, p 59-72, 1987. 6 fig, 22 ref, append.

Descriptors: *Coastal water, *Species compositon, *Benthic fauna, *Aquatic animals, *Lagoons, *Annelids, Tidal basins, Lake sediments, Animal populations, Polychaetes, Oligochaetes, Baseline studies.

In a spatial survey of macrozoobenthos in the lagoons of Albufeira and Obidos (west coast of Portugal), a study of the annelid fauna, based on the results from 107 sampling stations, was conducted. A list of 49 species (47 polychaetes and 2 oligochaetes) is given, 10 of which are new for the Portuguese coasts and one for the Iberian Peninsula. From a similarity analysis, two major coenotic assemblages were identified, both having the same distribution in each lagoon: (1) a coarse sand community that is restricted to the outer tidal channels with few but characteristic marine species; (2) a sandy mud community that is widespread in the inner parts, with a relatively rich fauna dominated by species typical of organically enriched sediments. (Author's abstract)
W88-10244

PHYTOPLANKTON, TRIPTON AND MICROPHYTOBENTHOS: TIDAL EXCHANGE IN A NORTH BRITTANY ESTUARY, (PHYTOPLANCTON, TRIPTON ET MICROPHYTOBENTHOS: ECHANGES AU COURS DE LA MAREE, DANS UN ESTUAIRE DU NORD-FINISTERE,),
Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
C. Riaux-Gobin.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 2, p 159-184, 1987. 8 fig, 5 tab, 30 ref.

Descriptors: *Phytoplankton, *Estuaries, *Aquatic populations, *Detritus, *Tripton, *Microorganisms, *Benthic flora, *Tides, *Tidal effects, Aquatic environments, Algae, Particulate matter, France.

In order to study the fluxes of particulate matter in an estuary with a large tidal range (mouth of the Dourduff River, Northern Brittany), samples for chlorophyll a, phaeopigments and seston were taken simultaneously with hydrological parameters at a fixed station, during several tidal cycles, and at different seasons. Seston, chlorophyll a and phaeopigments showed a maximum at slack water, low tide. The level, and moreover, the duration of the peak differs with the tidal amplitude and the season. During spring tides the maximum a concentration may be 30 times higher than that at high tide. The 'chlorophyll a/seston'; and the 'chlorophyll a/ phaeopigments' ratios are minimal during this peak, indicating the high percentage of detrital particles. Phytoplanktonic algae are scarce at low tide, whereas microphytobenthic pennate diatoms are abundant, whatever the season, indicating resuspension as the main source of the peak. Correspondence analysis gives a synthetic illustration of the short-term changes that occur in the hydrological parameters and particulate matter characteristics during the tidal cycle. Estimations of the integrated particle fluxes show two maxima per tidal cycle: one at mid-flood and the second at mid-ebb. This small estuary seems to export a consistent amount of particles to the nearby bay. (Author's abstract)
W88-10245

BIOACCUMULATION OF COPPER AND ZINC BY NEREIS DIVERSICOLOR (ANNELIDA, POLYCHAETA) IN THE BOU REGREG ESTUARY (MOROCCO)(BIOACCUMULATION DU CUIVERE ET DU ZINC CHEZ NEREIS DIVERSICOLOER (ANNELIDE POLYCHETE) DE L'ESTURAIRE DU BOU REGREG (MAROC)),
Laboratoire de Zoologie et d'Ecologie Marine, Angers (France).
For primary bibliographic entry see Field 5B.
W88-10249

SOME CHARACTERISTICS OF MACROBENTHIC FAUNA FROM THE ORGANIC-ENRICHED SEDIMENTS AT TALCAHUANO, CHILE,
Pontificia Univ. Catolica de Chile, Santiago.
For primary bibliographic entry see Field 5C.
W88-10250

POTENTIAL IMPACT OF LARGE-SCALE TIDAL POWER DEVELOPMENTS IN THE UPPER BAY OF FUNDY ON FISHERIES RESOURCES OF THE NORTHWEST ATLANTIC,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 6G.
W88-10283

BEHAVIORAL RESPONSES OF RED HAKE, UROPHYCIS CHUSS, TO DECREASING CONCENTRATIONS OF DISSOLVED OXYGEN,
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Lab.
For primary bibliographic entry see Field 5C.
W88-10285

FACTORS AFFECTING GROWTH RATES OF YOUNG TROPICAL FLOODPLAIN FISHES: SEASONALITY AND DENSITY-DEPENDENCE,
Illinois Natural History Survey, Champaign.
P. B. Bayley.
Environmental Biology of Fishes EBFID3, Vol. 21, No. 2, p 127-142, February 1988. 4 fig, 5 tab, 57 ref.

Descriptors: *Fish behavior, *Growth, *Model studies, *Seasonal variation, *Fish populations, Omnivores, Detritivores, Fish, Density, Biomass, Amazon River, Water level, Falling stage, Brazil, Fish diets, Tropic zone.

Deviations of growth increments from a model describing average growth of 12 common fish species, mostly juveniles, were compared with hydrological variables and biomass density (ranging from 1 g per sq m to 83 g per sq m) of potentially competing species of similar size ranges (guilds) in the littoral zone of the central Amazon floodplain (Brazil). Seasonal effects on growth were highly significant for omnivores but not detritivores. Omnivores exhibited faster growth during the rising water season. Higher growth rates were associated

with periods of increased rates of flooding during this season which could be associated with periods of increased availability of food. No species exhibited density-dependent growth when all seasons were considered together. During the rising water level season, no inverse relationship between growth and biomass density was found in any of the 11 species tested at $p = 0.05$. During the short falling water season, 2 of the 8 species tested did exhibit density-dependent growth but a sign test of correlation coefficients from all species was not significant. These two significant results were from four omnivores tested. However, density-dependent growth was not indicated when the data were pooled within either detritivore or omnivore guilds by hydrological season. It was concluded that with the possible exception of juvenile omnivores during the limited falling water season, density-dependent growth (and by implication interspecific competition) had no effect in regulating the species populations investigated in the floodplain environment. Conversely, the importance of a seasonal hydrological regime in maintaining growth rates, at least for omnivores, was evident. (Author's abstract)
W88-10286

AQUATIC MACROPHYTES IN THE SEA AREA AROUND THE LOVIISA NUCLEAR POWER STATION, SOUTH COAST OF FINLAND,
Finnish Centre for Radiation and Nuclear Safety, Helsinki.
For primary bibliographic entry see Field 5C.
W88-10297

SUMMER ICHTHYOPLANKTON COMMUNITIES OF TWO ESTUARINE SYSTEMS OF PRINCE EDWARD ISLAND,
Prince Edward Island Univ., Charlottetown. Dept. of Biology.
C. E. Johnston, and M. Morse.
Canadian Journal of Zoology CJZOAG, Vol. 66, No. 3, p 737-745, March 1988. 3 fig, 3 tab, 40 ref.

Descriptors: *Fish, *Plankton, *Estuarine fisheries, *Prince Edward Island, *Estuaries, *Species diversity, *Ecology, Seasonal variation, Environment, Eggs, Fish eggs, Growth stages, Larval growth stage, Juvenile growth stage, Flounders, Alewife, Species composition, Density, Population density, Coastal waters, Hillsborough River, Northumberland Strait,adie Bay, Saint Lawrence Gulf, Temperature effects, Salinity.

Fish eggs and (or) larvae representing 22 species in 14 families were collected during the summer of 1983 at eight stations in the Hillsborough River estuary-Northumberland Strait area and three stations in the Tracadie Bay-Gulf of St. Lawrence region. Of the 62,287 eggs collected, 83.5% were either yellowtail flounder, Limanda ferruginea, or cunner, Tautogolabrus adspersus, and 5.9% were Atlantic mackerel, Scomber scombrus. The most abundant larvae were alewife, Alosa pseudoharengus, Atlantic mackerel, and cunner accounting for 24.6, 22.4, and 20.6%, respectively, of the total 5,077 larvae and juveniles collected. The highest average concentration of eggs and larvae occurred in the coastal area near Tracadie Bay (4,265 eggs/100 cu m, 350 larvae/100 cu m), in the Northumberland Strait region (2,682 eggs/100 cu m), and at the head of the Hillsborough River system (170 larvae/100 cu m). The greatest species diversity occurred near Tracadie Bay (5.0 species of larval fish per tow) and in tracadie Bay channel (4.0 species of larval fish, 6.0 species of eggs per tow). Summer variations in abundance and distribution were correlated with water temperature and salinity for the more abundant species (alewife, cunner, Atlantic mackerel, Gasterosteus aculeatus, Morone americana, Osmerus mordax, Menidia menidia, Pseudopleuroenctes americanus). Species associations and station assemblages were analyzed using the Bray-Curtis dissimilarity measure and a numerical classification system. (Author's abstract)
W88-10412

DINOFLAGELLATE RESTING CYSTS ISOLATED FROM SEDIMENTS IN MARLBOROUGH SOUNDS, NEW ZEALAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
R. P. Baldwin.
New Zealand Journal of Marine and Freshwater Research, Vol. 21, No. 4, p 543-553, 1987. 26 fig, 39 ref.

Descriptors: *Dinoflagellates, *Cysts, *Dinoflagellate resting cysts, *Coastal waters, *Marine sediments, Species diversity, Spatial distribution, Gonyaulax, Peridinium, Benthic fauna, Shellfish farming, Toxins, New Zealand, Baseline studies.

Seventeen species of dinoflagellate resting cysts have been recorded for the first time in New Zealand. Isolated from sediments at 93 locations in the Marlborough Sounds, these were Gonyaulax spinifera, G. grindleyi, G. polyedra, G. digitalis, Gonyaulax sp., Protoperidinium subinerme, P. pentagonum, P. conicum, P. oblongum, P. leonis, P. cf. punctulatum, P. cf. conicoides, Peridinium stelatum, Peridinium sp., Scrippsiella trochoidea, Polykrikos schwartzii, and Diplopsalis sp. Where possible their identities were confirmed by hatching experiments yielding live motile cells. None of the cysts found in the sediments has been implicated in human illnesses involving the ingestion of contaminated shellfish. Greatest cyst concentrations and species diversity were found in Kenepuru Sound and Tennyson Inlet. These areas may be more likely to harbor toxic species causing paralytic shellfish poisoning or diarrhetic shellfish poisoning, if these were to appear in the future. (Author's abstract)
W88-10438

BIOLOGICAL EFFECTS OF DREDGING IN AN OFFSHORE BORROW AREA,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 4C.
W88-10444

PRIMARY PRODUCTION IN THREE SUB-TROPICAL SEAGRASS COMMUNITIES: A COMPARISON OF FOUR AUTOTROPHIC COMPONENTS,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
P. R. Jensen, and R. A. Gibson.
Florida Scientist FLSCA, Vol. 49, No. 3, p 129-141, Summer 1986. 3 fig, 2 tab, 44 ref.

Descriptors: *Primary productivity, *Subtropic zone, *Sea grasses, *Benthic flora, *Algae, *Coastal waters, Photosynthesis, Marine environment, Comparison studies, Epiphytes, Phytoplankton, Biomass, Ecosystems, Estuaries, Lagoons, Nutrients, Florida, Bahamas.

A one-year study was conducted in which seagrass communities in Tampa Bay, the Indian River Lagoon, and the Little Bahama Bank were monitored quarterly for primary production, standing stock biomass, and nurient concentrations. Primary production rates were measured in situ for the following four community autotrophic components: seagrasses, their associated epiphytic flora, phytoplankton and microbenthic algae. Photosynthetic rates were compared both within and between locations to determine the relative significance of the primary producers, and the contribution by each to areal, i.e., community production (mg C/cu m/h). In general, all species of seagrasses, their associated epiphytic flora and microbenthic algae produced at similar rates at all locations. The Indian River Lagoon had phytoplankton primary production rates that were greater than both seagrass and microbenthic algal production rates. Phytoplankton in Tampa Bay had primary production rates greater than all other community photosynthetic components, and primary production rates by all photosynthetic components in the nutrient-depleted Bahama Banks were similar. Therefore, the majority of the community primary production, i.e., the production base, in Tampa Bay and the Indian River Lagoon is contributed by phytoplankton. These areas are characterized by anthropogenic perturbations and associated high nutrient concentrations. Historical data indicated that phytoplankton, turtle grass and microbenthic algae were, at one time, equally productive in Tampa Bay. Increased phytoplankton production has reduced the relative importance of seagrasses and microbenthic algae to community production in this area. It is suggested that the relative contributions by the components of the photosynthetic community are affected by nutrient availability. Nutrient enrichment may induce a shift in the production base from benthic plants to phytoplankton. A shift of this type may be interpreted as an ecological indicator of either eutrophication or environmental stress in a coastal marine environment. (Author's abstract)
W88-10446

SEASONAL FLUCTUATIONS OF SALINITY AND FISH OCCURRENCE IN AND AROUND EPE LAGOON, NIGERIA,
Kainji Lake Research Inst., New Bussa (Nigeria).
J. K. Balogun.
African Journal of Ecology AJOED, Vol. 25, No. 1, p 55-61, March 1987. 3 fig, 1 tab, 11 ref, append.

Descriptors: *Nigeria, *Estuarine fisheries, *Fish, *Epe Lagoon, *Estuarine environment, Seasonal variation, Seasonal distribution, Saline-freshwater interfaces, Africa, Hydrogen ion concentration, Salinity, Dissolved oxygen, Species diversity, Aquatic habitats, Temperature, Tropical regions.

This study aimed to investigate (1) seasonal variation in physico-chemical parameters in the Epe Lagoon and along the waterways and (2) seasonal occurrence and relative catches of fish species form the lagoon. Bimonthly sampling was done from December 1978 to March 1980 with temperature, salinity, pH, and dissolved oxygen values recorded. Fish species data obtained from fishermen's catches consisted of 34 families representing 56 species classified as marine, freshwater, or euryhaline. The distribution of marine, brackish, and freshwater species is largely dictated by salinity, with changes in other physico-chemical parameters affecting the aquatic fauna when levels exceed the tolerance zone. Surface water temperature (25-31 C) and the pH range (6.8-7.55) were within the tolerance range for tropical aquatic fauna. Dissolved oxygen levels remained high throughout the year. Seasonal changes in fish occurrence are related to salinity changes. The pattern of fish distribution along the waterways indicates that highly saline waters are the optimal environment. The diversity indices were lowest in the freshwater area and rose with increasing salinity. (White-Reimer-PTT)
W88-10482

STUDY OF AN EXTRACTION PROCEDURE FOR ORGANIC TRACE LEVELS: SOME RESULTS CONCERNING HYDROCARBONS IN MARINE SEDIMENTS.
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Chimique.
For primary bibliographic entry see Field 5A.
W88-10521

DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN INDIGENOUS AND TRANSPLANTED MUSSELS (MYTILUS EDULIS L.) ALONG THE DUTCH COAST,
Hoofdgroep Maatschappelijke Technologie TNO, Apeldoorn (Netherlands).
For primary bibliographic entry see Field 5A.
W88-10537

QUALITY ASSURANCE STUDY FOR THE ANALYSIS OF HYDROCARBONS IN SEDIMENTS,
Instituto de Quimica Bio-Organica, Barcelona (Spain). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W88-10539

CONTAMINATION OF THE SUPERFICIAL WATERS OF THE GULF OF FOS-SUR-MER BY ANIONIC DETERGENTS,
Centre d'Oceanologie de Marseille (France).

For primary bibliographic entry see Field 5B.
W88-10549

IMPORTANCE OF STANDING DEAD SHOOTS OF THE NARROW LEAVED CATTAIL, TYPHA ANGUSTIFOLIA L.,
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 2H.
W88-10555

SEDIMENT DISPERSAL IN THE KNYSNA ESTUARY: ENVIRONMENTAL MANAGEMENT CONSIDERATIONS,
Port Elizabeth Univ. (South Africa). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W88-10563

EFFECTS OF RIVER FLOODS ON SEDIMENT DISPERSAL IN SMALL ESTUARIES: A CASE STUDY FROM EAST LONDON,
Port Elizabeth Univ. (South Africa). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W88-10564

PLATHELMINTH ABUNDANCE IN NORTH SEA SALT MARSHES: ENVIRONMENTAL INSTABILITY CAUSES HIGH DIVERSITY,
Goettingen Univ. (Germany, F.R.). Zoologisches Inst. und Museum.
W. Armonies.
Helgolaender Meeresuntersuchungen HEMEDC, Vol. 40, No. 3, p 229-240, 1986. 7 fig, 7 tab, 16 ref.

Descriptors: *Wetlands, *Platyhelminthes, *Species diversity, *Ecosystems, *North Sea, *Salt marshes, Aquatic fauna, Salinity, Seasonal variations, Littoral zone.

Although supralittoral salt marshes are habitats of high environmental instability, the meiofauna is rich in species and abundance is high. The community structure of free-living Platyhelminthes (Turbellaria) in these salt marshes is described. On an average, 104 individuals were found in an area of 10 sq cm. The average species density in ungrazed salt marshes is 11.3 per 10 sq cm and 45.2 per 100 sq cm, indicating strong small-scale heterogeneity. The faunal similarity between sediment and the corresponding above-ground vegetation is higher than between adjacent sample sites. Species prefer distinct ranges of salinity. In the lower part of the supralittoral salt marshes, the annual fluctuations of salinity are strongest and highly unpredictable. This region is richest in plathelminth species and abundance; diversity is highest, and the faunal composition of parallel samples is quite similar. In the upper part of the supralittoral salt marshes, the annual variability of salinity is lower, platyhelminths are poor in species diversity and abundance. Parallel samples often have no species in common. Thus, those salt marsh regions with the most unstable environments are inhabited by the most diverse species assemblage. Compared to other littoral zones of the North Sea, however, platyhelminth diversity in salt marshes is low. The observed platyhelminth diversity pattern can apparently be explained by the 'dynamic equilibrium model.' (Author's abstract)
W88-10629

IMPORTANCE OF GRAZING FOOD CHAIN FOR ENERGY FLOW AND PRODUCTION IN THREE INTERTIDAL SAND BOTTOM COMMUNITIES OF THE NORTHERN WADDEN SEA,
Biologische Anstalt Helgoland (Germany, F.R.)
H. Asmus, and R. Asmus.
Helgolaender Meeresuntersuchungen HEMEDC, Vol. 40, No. 3, p 273-301, 1986. 8 fig, 6 tab, 98 ref.

Descriptors: *Food chains, *Ecosystems, *Intertidal areas, *Coastal waters, *Food habits, *Gastropods, *Aquatic productivity, Energy transfer, Tidal pools, Metabolism, Aquatic populations, Mollusks, Benthic fauna, Primary productivity, Seasonal variations, Biomass, Sand, North Sea.

In three intertidal sand bottom communities of the 'Konigshafen' (Island of Sylt, North Sea), the biomass production and respiration of phytobenthos, phytoplankton, macrozoobenthos, and in situ community metabolism were measured monthly during 1980. The study sites were characterized by different communities (Nereis-Corophium-belt, seagrass-bed, Arenicola-flat) and by a high abundance of the mollusk Hydrobia ulvae. Benthic diatoms are the major constituents of plant biomass in the Arenicola-flat. In this m/a community, gross primary productivity amounts to 148 g C/sq m/a. 82% of this productivity is caused by microbenthos, whereas phytoplankton constitutes only 18%. In the seagrass-bed, gross primary productivity amounts to 473 g C/sq m/a. 79% of this is generated by seagrass and its epiphytes, whereas microphytobenthos contributes 19%. In the Nereis-Corophium-belt, only microphytobenthos is important for biomass and primary productivity (gross: 152 g C/sq m/a). Annual production of macrofauna proved to be similar in the Arenicola-flat (30 g C/sq m/a) to that in the seagrass-bed (29 g C/sq m/a). Only one third of this amount is produced in the Nereis-Corophium-belt (10 g C/sq m/a). The main part of secondary production and animal respiration is contributed by grazing H. ulvae. In the seagrass-bed, 83% of the energy used from production is obtained from the grazing food chain. in the Arenicola-flat and the Nereis-Corophium-belt, the importance of non-grazing species is greater. A synchrony of seasonal development of plant biomass and monthly secondary production was observed. In the Arenicola-flat and the seagrass-bed, where density and production of macrofauna are high, a conspicuous decrease in biomass of microbenthos occurs during the warmer season, whereas in the Nereis-Corophium-belt primary production cause an increase in microphytobenthic biomass in summer and autumn. Based on the assumption that sources of food are used in proportion to their availability, 49 g C/sq m/a (Arenicola-flat), 72 g C/sq m/a (seagrass-bed) and 26 g C/sq m/a (Nereis-Corophium-belt) are estimated as taken up by the grazing food chain. (Author's abstract)
W88-10630

SATELLITE DETECTION OF BLOOM AND PIGMENT DISTRIBUTIONS IN ESTUARIES,
National Oceanic and Atmospheric Administration, Washington, DC. Assessment and Information Services Center.
For primary bibliographic entry see Field 7B.
W88-10725

POPULATIONS OF METHANOGENIC BACTERIA IN A GEORGIA SALT MARSH,
Georgia Univ., Athens. Dept. of Microbiology.
M. J. Franklin, W. J. Wiebe, and W. B. Whitman.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 5, p 1151-1157, May 1988. 1 fig, 7 tab, 45 ref. NSF Grants DMB83-51355 and BSR-8304928.

Descriptors: *Aquatic bacteria, *Methanogenic bacteria, *Aquatic habitats, *Salt marshes, Population dynamics, Species composition, Aquatic plants, Georgia, Metabolism, Nutrition, Cycling nutrients, Sediments, Spatial distribution, Bacteria.

Methanogens represented about 0.5% of the total bacteria in sediments from a Georgia salt marsh in which Spartina alterniflora is the predominant vegetation. The population of methanogens was composed of at least two groups of nearly equal size. One group was represented by cocci which were able to utilize trimethylamine and were unable to use H2 or acetate. The second group was composed of two subgroups which were able to utilize H2 but were unable to use trimethylamine or acetate. The more common subgroup included rod- or plate-shaped methanogens which could utilize isopropanol in addition to H2 and formate. The second subgroup included Methanococcus maripaludis, which utilized only H2 and formate. Other groups of methanogens were also present, including Methanosarcina sp. which utilized acetate, H2, and methylamines. In addition to the overall variability in the types of methanogens, the numbers of methanogens in sediments also exhibited significant spatial variability both within and between tall- and short-Spartina zones. (Author's abstract)
W88-10738

OCCURRENCE AND MECHANISMS OF MICROBIAL OXIDATION OF MANGANESE,
Wisconsin Univ.-Milwaukee. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2K.
W88-10742

INFLUENCE OF HABITAT STRUCTURE ON THE FISH ASSEMBLAGES ASSOCIATED WITH TWO COOLING-WATER INTAKE STRUCTURES IN SOUTHERN CALIFORNIA,
Occidental Coll., Los Angeles, CA. Dept. of Biology.
M. Helvey, and R. W. Smith.
Bulletin of Marine Science BMRSAW, Vol. 37, No. 1, p 189-199, July 1985. 2 fig, 7 tab, 35 ref.

Descriptors: *Intakes, *Reefs, *Riprap, *Aquatic habitats, *Electric powerplants, *Species composition, Population dynamics, Aquatic plants, Food habits, Food chains, Spatial distribution, Fish, California, Aquatic animals, Coastal waters.

The offshore intake structures of coastal electric power generating stations in southern California consist of high relief conduits surrounded by structurally complex rock rip-rap. In order to determine what component of an intake's fish assemblage was associated directly with the rip-rap, fish communities at two intake structures and four other artificial reefs lacking either high relief or complex habitat substrata were compared. Results indicated that all reefs were nearly comparable in species number and number of individuals for water-column oriented species regardless of habitat type. The ubiquity of a majority of water-column species at all reefs suggests that the provision of a visual landmark or hard surfaces supporting algal and invertebrate populations is essential for concentrating these species. In contrast, the presence of most benthic species was directly related to habitat cover as a reef with no habitat refuge and a reef with complex habitat but large interstitial spaces both had depauperate benthic species assemblages. Vertical diversity rather than substrate rugosity proved to be a better indicator for relating fish community structure to habitat structure. (Author's abstract)
W88-10749

REPRODUCTIVE BIOLOGY, SEASONALITY AND DISTRIBUTION OF TENAGOMYSIS MACROPSIS W. TATTERSALL, 1923 (CRUSTACEA, MYSIDACEA) IN A NEW ZEALAND ESTUARY,
Queensland Univ., Brisbane (Australia). Dept. of Zoology.
J. G. Greenwood, M. B. Jones, and J. Greenwood.
Bulletin of Marine Science BMRSAW, Vol. 37, No. 2, p 538-555, September 1985. 9 fig, 6 tab, 26 ref.

Descriptors: *Estuaries, *Tenagomysis, *Crustaceans, *Reproduction, *Coastal waters, Temperature effects, Salt tolerance, Aquatic habitats, Aquatic animals, New Zealand, Seasonal variation, Spatial distribution, Population dynamics.

Populations of Tenagomysis macropsis in a shallow New Zealand estuarine embayment were sampled monthly for 14 months. Size at maturity averaged 6.4-8.7 mm for males, 6.6-8.8 mm for females, and varied seasonally showing strong inverse correlation with temperature. Mean number of stage 1 young per brood was 11, the number and size of these being correlated with female body-size and therefore varying seasonally also. During winter the population contained a maximum percentage of large females producing maximum numbers of large embryos. Brood mortality approximates 20%. The sampled population was found in salinities averaging 4-30o/oo with maximum numbers in waters of 19o/oo. Salinity tolerance tests confirmed a salinity optimum in the vicinity of 20o/oo

but demonstrated broad euryhalinity. Population numbers were lowest during summer and early autumn, highest during late winter/spring. Data did not demonstrate a consistent seasonal population cycle, and it is suggested this was related to differing salinity regimes, recruitment rates, breeding aggregation and migration. The population showed significant differences in distribution in spring, especially of adult females and to a lesser extent of juveniles. This may be part of a broader inshore-offshore migration pattern. Large sexually differentiated individuals dominated (90%) the winter population, the first sexually mature individuals having appeared in late autumn. Reproductive activity resulted in a new recruitment by late winter which continued through summer and autumn. The population was dominated by juveniles during summer, by which time the overwintering adult cohort was lost. Females dominated the population, probably producing more than one brood per year, and having a longevity of one year. Early post-mating mortality of males is indicated. (Author's abstract)
W88-10750

RELATIONSHIP BETWEEN PINK SHRIMP PRODUCTION ON THE TORTUGAS GROUNDS AND WATER FLOW PATTERNS IN THE FLORIDA EVERGLADES,
National Marine Fisheries Service, Miami, FL. Southeast Fisheries Center.
J. A. Browder.
Bulletin of Marine Science BMRSAW, Vol. 37, No. 3, p 839-856, November 1985. 10 fig, 6 tab, 22 ref.

Descriptors: *Estuarine fisheries, *Salinity, *Coastal waters, *Shrimp, *Crustaceans, *Water level fluctuations, Aquatic habitats, Aquatic animals, Reproduction, Tortugas Grounds, Everglades, Florida, Estuaries, Flow pattern, Statistical methods, Seasonal variation.

Regression analysis indicated a relationship between landings of pink shrimp on the Tortugas grounds and freshwater runoff to the estuarine areas of Everglades National Park, as indexed by water levels in the park. A strong positive relationship between quarterly (3-month) landings and the average water level of the previous quarter was found for three quarters of the year. October through December water levels, followed by July through September water levels, may have had the greatest influence on annual landings. An inverse relationship between landings and water levels from April through June was not precluded. Information of this type is needed in order that the freshwater needs of estuarine-dependent marine organisms can be taken into account in water management planning. (Author's abstract)
W88-10751

PHOTOSYNTHESIS AND LIGHT IN ESTUARINE BENTHIC MICROALGAE,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Brewing and Biological Sciences.
D. K. Mills, and M. Wilkinson.
Botanica Marina BOTNA7, Vol. 29, No. 2, p 125-129, March 1986. 3 fig, 2 tab, 25 ref.

Descriptors: *Benthic flora, *Algae, *Microalgae, *Estuaries, *Photosynthesis, *Light quality, Chlorophyll a, Aquatic habitats, Aquatic plants, Limiting nutrients.

The photosynthetic rate of natural populations of benthic microalgae was determined in the laboratory over a range of irradiances and at 15 and 20 C. Values for maximum gross photosynthesis 5.3 and 11.7 microg oxygen/microg chlorophyll A/H and the initial slope of of the photosynthesis versus irradiance curve 0.035 and 0.031 microg oxygen/microg chlorophyll A/H/(microE/sq M/S) at 20 and 15 C, fell within the ranges quoted by a number of other workers. However, the overall response of the microalgae to light suggested that they were from a 'sun adapted' algal community. No photoinhibition was observed, even after 2 hours exposure to the highest irradiance. The low value calculated for quantum efficiency suggest that these organisms were nutrient limited. (Author's abstract)
W88-10752

REPRODUCTIVE PHENOLOGY AND GROWTH OF GRACILARIA TIKVAHIAE MCLACHLAN (GIGARTINALES, RHODOPHYTA) IN THE GREAT BAY ESTUARY, NEW HAMPSHIRE,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
C. A. Penniman, A. C. Mathieson, and C. E. Penniman.
Botanica Marina BOTNA7, Vol. 29, No. 2, p 147-154, March 1986. 7 fig, 3 tab, 59 ref.

Descriptors: *Estuaries, *Plant growth, *Rhodophyta, *Gracilaria, *Phenology, *Reproduction, *Coastal waters, Aquatic plants, Aquatic habitats, Great Bay Estuary, Seasonal variation, Temperature effects, Light quality, Limiting nutrients, Growth, New Hampshire.

The reproductive phenology of Gracilaria tikvahiae from the Great Bay Estuary, New Hampshire, was evaluated monthly during May 1976 to October 1977. The plants were vegetative throughout most of the study period. However, discrete maxima of tetrasporic and spermatangial plants occurred during June-July, while cystocarpic plants were maximal during July-August. The in situ growth of G. tikvahiae, measured during April 1978 to August 1979, was maximal during June-August, and minimal during the winter. The growth of G. tikvahiae was most strongly correlated with water temperature, while seasonal variations of surface irradiance and dissolved inorganic nitrogen were not significantly correlated to the growth cycle. (Author's abstract)
W88-10753

EFFECTS OF SEDIMENTARY PROCESSES AND SALINITY ON THE DIATOM FLORA OF THE COLUMBIA RIVER ESTUARY,
Lewis and Clark Coll., Portland, OR. Dept. of Biology.
M. C. Amspoker, and C. D. McIntire.
Botanica Marina BOTNA7, Vol. 29, No. 5, p 391-399, September 1986. 2 fig, 4 tab, 24 ref.

Descriptors: *Columbia River Estuary, *Estuaries, *Salinity, *Diatoms, *Species composition, Spatial distribution, Population dynamics, Phytoplankton, Seasonal variation, Hydrology, Sediments, Benthic flora.

Effects of sediment properties and salinity on distributional patterns in sediment-associated and planktonic diatom assemblages were investigated in the Columbia River Estuary. The benthic diatom flora was characterized by the virtual absence of marine taxa, a relatively restricted distribution of brackish-water species, and widely distributed assemblages of freshwater species. The dominance of freshwater taxa in the phytoplankton was further evidence of a strong fluvial influence in the estuary. In the lower estuary, there was a lack of seasonal variation in the species composition of the benthic flora which was attributed to the relatively high degree of sediment stability in this region. However, corresponding seasonal changes in the upper estuary were more pronounced, a pattern explained in part by seasonal inputs of allochthonous planktonic taxa to the sediments and by the hydrologic processes of erosion and accretion which influence the relative abundances of epipelic and epipsammic species. (Author's abstract)
W88-10754

BALTIC EUTROPHICATION: A CONTRIBUTION TO THE DISCUSSION,
L.-E. Persson.
Ophelia OPHLAN, Vol. 27, No. 1, p 31-42, April 1987. 2 fig, 3 tab, 46 ref.

Descriptors: *Benthic fauna, *Baltic Sea, *Eutrophication, *Biomass, Species composition, Population dynamics, Aquatic habitats, Aquatic animals, Food habits, Food chains, Spatial distribution, Cycling nutrients, Fish, Macroinvertebrates.

Quantitative sampling of macrozoobenthos has been performed in the southern Baltic in the 1920s and the 1950s. Some of these stations (43) were revisited in 1982/83. The total abundance and biomass was significantly increased in 1982/83 compared to 1921. A small, non-significant, increase in biomass was found in 1982/83 compared to the 1950s. It is suggested that the main part of the biomass increase might be due to reduced stocks of predatory flatfishes in the 1920s and 1930s. The most conspicuous difference in the comparisons is the widespread distribution of the polychaete Capitella capitata in 1982/83. This is attributed to increased trawling activities in recent decades and not to organic enrichment. (Author's abstract)
W88-10756

ECOLOGY, GROWTH AND PRODUCTION OF THYASIRA FLEXUOSA (BIVALVIA, LUCINACEA) FROM RIA DE LA CORUNA, NORTH-WEST SPAIN,
Instituto Espanol de Oceanographia, La Coruna (Spain). Centro Costero del La Coruna.
E. Lopez-Jamar, G. Gonzalez, and J. Mejuto.
Ophelia OPHLAN, Vol. 27, No. 2, p 111-126, May 1987. 7 fig, 4 tab, 44 ref.

Descriptors: *Coastal waters, *Animal growth, *Succession, *Mollusks, *Population dynamics, Productivity, Spatial distribution, Species composition, Aquatic habitats, Aquatic animals, Water pollution effects, Hydrocarbons, Seasonal variation, Growth, Ria de la Coruna.

The population dynamics, growth and production of Thyasira flexuosa have been studied over a three year period in Ria de La Coruna, North-west Spain. During recolonization of the sediment after harbour dredging operations, T. flexuosa was the macro-infaunal dominant and three successive cohorts could be followed over time. Densities were very high during most of the study period. This species seems to be associated with high values or organic matter in the sediment and it is tolerant of hydrocarbon pollution. Newly settled individuals appeared in the samples from January to late spring, with a marked peak in April-May. The intensity of recruitment did not vary much from one year to another. The mean size of individuals of Thyasira flexuosa was 3.2 and 4.8 mm at the end of the first and second year of life, respectively, although individual growth rates showed large variations. The mean production was 4.7 g/sq m/year, with a mean production/biomass ratio of 1.39. Variations in growth and production from year to year were mainly due to intraspecific competition related to the high densities. Values of growth and production are compared with other bivalve species and general data on ecology are provided. (Author's abstract)
W88-10758

POPULATION DYNAMICS OF MACOMA BALTHICA IN THE DANISH WADDEN SEA IN AN ORGANICALLY ENRICHED AREA,
For primary bibliographic entry see Field 5C.
W88-10760

MOTILE EPIFAUNA OF MARINE MACROPHYTES IN THE INDIAN RIVER LAGOON, FLORIDA: I. COMPARISONS AMONG THE THREE SPECIES OF SEAGRASSES FROM ADJACENT BEDS,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
For primary bibliographic entry see Field 2H.
W88-10773

MOTILE EPIFAUNA OF MARINE MACROPHYTES IN THE INDIAN RIVER LAGOON, FLORIDA: II. COMPARISONS BETWEEN DRIFT ALGAE AND THREE SPECIES OF SEAGRASSES,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
For primary bibliographic entry see Field 2H.
W88-10774

DISTRIBUTION, GROWTH AND MORTALITY OF LARVAL SPOTTED SEATROUT, CYNOSCION NEBULOSUS: A COMPARISON BETWEEN TWO ADJACENT ESTUARINE AREAS OF SOUTHWEST FLORIDA,
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 2H.
W88-10775

TEMPORAL CHANGES IN THE SEDIMENT GEOCHEMISTRY OF TWO SOUTHEAST ALASKAN FJORDS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
S. F. Sugai.
Deep-Sea Research DESRAY, Vol. 34, No. 5/6, p 913-925, May/June 1987. 8 fig, 1 tab, 27 ref. Department of Energy Contract E(45-1)-2229.

Descriptors: *Estuaries, *Sediments, *Geochemistry, *Alaska, *Estuaries, *Trace metals, *Nutrients, Interstitial water, Seasonal variation, Temporal distribution, Thermodynamics, Iron, Manganese, Phosphate, Ammonium, Organic matter, Smeaton, Bay Fjords.

Monthly variations in trace metal and nutrition distributions in interstitial water were examined in Smeaton Bay and Boca de Quadra, two deep fjords where bottom water temperatures vary < 1 C. In Smeaton Bay, episodic sediment mixing and seasonal changes in the supply of reactive organic matter were responsible for the temporal variations observed. Mixing incidents were most frequent in the autumn and winter, leading to oxidation of the pore waters. Interstitial waters became more reducing following the spring deposition of autochthonous carbon, leading to increased concentrations of Mn(+2). However, reducing conditions in sediments from the main basin of Boca de Quadra persisted throughout the year and the seasonal availability of organic material to the sediment resulted in higher concentrations of Mn(+2) and Fe(+2) in late summer. Thermodynamic calculations indicate that surface interstitial waters from Boca de Quadra may have been saturated with respect to rhodochrosite or a similar Mn carbonate. The interstitial waters from Smeaton Bay may have approached saturation with respect to siderite (the Fe carbonate) in April 1980, but were considerably undersaturated by October 1980. (Author's abstract)
W88-10783

EXTENT AND INTENSITY OF THE ANOXIC ZONE ON BASINS AND FJORDS,
Washington Univ., Seattle. Fisheries Research Inst.
J. J. Anderson, and A. H. Devol.
Deep-Sea Research DESRAY, Vol. 34, No. 5/6, p 927-944, May/June 1987. 9 fig, 2 tab, 30 ref. NSF Grant OCE 83-08653.

Descriptors: *Estuaries, *Anoxic zone, *Fjords, *Model studies, *Oxygen, *Sulfides, Hydrogen sulfide, Respiration, Oxygen transfer, Advection, Sediments.

A model was developed to describe the extent and intensity of the anoxic zone of semi-enclosed basins. Vertical profiles of oxygen and hydrogen sulfide can be modeled by normalizing depth to the sill and bottom depths of the basin, and oxygen and sulfide to the oxygen concentration at sill depth. Profile shapes are controlled by three model parameters that express the ratio of in situ respiration to diffusion, the ratio of oxygen diffusion to advection and the ratio of sulfide production to oxygen diffusion. Anoxic basins fall into three categories when compared in terms of their normalized interface depth and normalized bottom sulfide concentrations. Analysis of the three groups suggests that one group represents basins not in equilibrium. The other two groups represent basins in equilibrium: one, with relatively linear sulfide profiles dominated by sulfide production in the sediments, and the other with curved sulfide profiles in which sulfide production in both the water column and sediments is important. (Author's abstract)
W88-10784

NUTRIENT REGENERATION AND DENITRIFICATION IN LOW OXYGEN FJORDS,
Lamont-Doherty Geological Observatory, Palisades, NY.
W. M. Smethie.
Deep-Sea Research DESRAY, Vol. 34, No. 5/6, p 983-1006, May/June 1987. 9 fig, 4 tab, 38 ref. NSF grants GA-24875 and OCE 74-02665.

Descriptors: *Estuaries, *Nutrients, *Fjords, *Denitrification, *Cycling nutrients, *Oxygen uptake, *Nitrification, Aerobic conditions, Respiration, Phosphates, Sulfates, Sediments, Canada.

Rates of oxygen consumption, denitrification, nitrification and sulfate reduction were determined from temporal changes of oxygen, phosphate, nitrate, nitrite and ammonium in the stagnant bottom water of two fjords, Narrows Inlet and Princess Louisa Inlet, which are part of the Jervis Inlet system in British Columbia, Canada. Rates of nutrient regeneration and microbial respiratory processes for the deep regions of Narrows Inlet and Princess Louisa Inlet were calculated from observed changes in oxygen and nutrient concentrations during summer months when the deep water was stagnant. The mean oxygen consumption rate, normalized to area of sediment, was 0.45-0.55 microg-at/sq m/sec for Narrows Inlet and 0.71 microg-at/sq m/sec for Princess Louisa Inlet. The mean phosphate regeneration rate was 0.0023 microg-at/sq m/sec for Narrow Inlet and 0.0049 microg-at/sq m/sec for Princess Louisa Inlet. Rates of denitrification ranged from 0.016 to 0.073 microg-at/sq/m sec at Narrows Inlet and 0.075 to 0.101 microg-at/sq m/sec at Princess Louisa Inlet. The range in sulfate reduction rates was 0.018-0.082 microg-at/sq m/sec for Narrows Inlet and 0.089-0.102 microg-at/sq m/sec for Princess Louisa Inlet. The denitrification rates are high compared to rates determined for other coastal and inshore environments. This appears to be caused by a combination of very low oxygen water overlying the sediments which allows the denitrification zone to be at or very close to the sediment-water interface, and a strong coupling between nitrification and denitrification in which ammonium released by sulfate reduction in the sediments diffuses into the aerobic zone and is oxidized to nitrogen species that are then consumed by denitrification. The nitrification-denitrification couple probably occurs widely in coastal and continental shelf sediments and sedimentary denitrification may exceed denitrification that occurs in the oxygen deficient portions of the oceanic water column. (Author's Abstract)
W88-10785

DIATOM ABUNDANCE IN THE ESTUARIES,
Madras Univ. (India).
V. N. R. Rao, and G. Ragothaman.
Current Science CUSCAM, Vol. 57, No. 7, p 383-384, April 5 1988. 2 fig, 1 tab, 6 ref.

Descriptors: *Estuaries, *Diatoms, *Salinity, *Rivers, Phytoplankton, Cyclotella, Adaptation.

Two diatoms, Cyclotella meneghiniana and Amphora coffeaeformis, occur in the Cooum and Adyar estuaries in India where salinity varies from almost freshwater to very near that of the sea. A number of clones of the two diatoms were isolated in several locations: (1) from upstream of the estuaries where there is no tidal influence, (2) from the estuaries themselves, and (3) from several places in the Bay of Madras. The behavior of these clones in relation to salinity of the medium was studied in the laboratory and clones isolated from a garden pond were included for comparison. The ability of Cyclotella meneghiniana to grow in estuaries apparently involves efficient maintenance of a small inoculum throughout the year in various places in the river and the sea and effective use of changes in salinity to trigger auxospore formation. The synchronization of its life cycle to changes in the hydrology of the habitat is required. Amphora coffeaeformis isolated from a particular salinity grew best at that salinity and differences in their behavior seem to be related to the place of origin. (Miller-PTT)
W88-10787

INVASION OF SCHINUS INTO SALINE COMMUNITIES OF EVERGLADES NATIONAL PARK,
Louisiana State Univ., Baton Rouge. Dept. of Botany.
L. Mytinger, and G. B. Williamson.
Florida Scientist FLSCA, Vol. 50, No. 1, p 7-12, Winter 1987. 2 fig, 1 tab, 11 ref.

Descriptors: *Trees, *Everglades National Park, *Plant populations, *Salt tolerance, Saline water, Saline soils, Germination.

The tolerance of Schinus terebinthifolius to saline conditions was investigated to determine its ability to invade and establish in coastal communities of the Everglades National Park. Viability of seed soaked in salt solutions for 72 hours declined as salinity increased, although 60% of the seeds were viable after soaking in 40 ppt salt solution. Germination rates in petri dishes declined more sharply with salinity increases, with only 12% germination at 20 ppt salt solution. On native soils treated with salt solutions, germination never occurred at salinities higher than 5 ppt. Survival of seedlings transplanted into field sites occurred only where soil salinities were 5 ppt or less. The findings suggest that Schinus is a potential threat to halophytic plant communities only where freshwater has replaced the higher salinity waters that initially fostered the salt tolerant plants. (Author's abstract)
W88-10804

POTENTIAL CONTRIBUTION OF NATURAL HYDROCARBON SEEPAGE TO BENTHIC PRODUCTIVITY AND THE FISHERIES OF ATLANTIC CANADA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
E. M. Levy, and K. Lee.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 349-352, February 1988. 25 ref.

Descriptors: *Coastal waters, *Oil pollution, *Benthic fauna, *Productivity, *Hydrocarbons, *Fisheries, *Seepage, Ocean bottom, Methane, Canada, Atlantic Ocean.

Bacterial processes involving methane and other low molecular weight hydrocarbons may be a substantial contribution to the overall benthic productivity in areas where natural seepage from the seabed occurs. This process may be sufficiently extensive on the continental shelf off the east coast of Canada to be of importance to the fishery. Although a brief chemical survey did not provide conclusive evidence of seepage on the Grande Banks, gas-charged sediments and patches of 'white slime' were observed on the seafloor during geological investigations of the Hibernia area and a gas 'leak' has been reported on the northeast slope of the bands nearby. On George Bank where there are extremely valuable fisheries for scallops and groundfish and there is sufficient potential for petroleum that exploratory drilling is being considered, remarkably high concentrations of methane and other low-molecular-weight hydrocarbons were found in surficial bottom sediments during a recent survey. Since biodegradation has the additional effect of 'detoxifying' the environment in regions where natural seepage occurs and the benthos has successfully adapted to and thrives under conditions that would normally be detremental or even intolerable, bacterial processes can readily account for the many examples globally where lucrative fisheries exist in areas of petroleum reserves. By considering photosynthesis and chemosynthesis together, a solution may be offered both to the long-standing problems associated with the management of the fishery and to the stalemate regarding the coexistence of the fishing and offshore oil industries -- two industries that have all too often been assumed in the past to be incompatible. (Friedmann-PTT)
W88-10837

SEDIMENTATION IN AN EBB-TIDAL DELTA, RANGAUNU HARBOUR, NORTHLAND, NEW ZEALAND,

Department of Scientific and Industrial Research, Wellington (New Zealand). Oceanographic Inst.
For primary bibliographic entry see Field 2J.
W88-10844

DEGRADATION OF MANGROVE LEAF LITTER IN THE ST. LUCIA ESTUARY AS INFLUENCED BY SEASON AND EXPOSURE,
Durban-Westville Univ. (South Africa). Dept. of Botany.
T. D. Steinke, and C. J. Ward.
South African Journal of Botany, Vol. 53, No. 5, p 323-328, October 1987. 6 fig, 4 tab, 25 ref.

Descriptors: *Mangrove swamps, *Leaves, *Litter, *Cycling nutrients, *Decomposing organic matter, *Estuaries, *Biodegradation, Nitrogen, Decomposition, Wetlands, Saint Lucia Estuary, Seasonal variation, Temperature effects, Phosphorus, Potassium, South Africa, Ecology.

Rates of degradation of leaves of Avicennia marina (Forssk.) Vierh. and Bruguiera gynmorrhiza (L.) Lam. were investigated in St. Lucia Estuary in the warm and cool seasons at three positions on the shore: where leaves were constantly submerged, where they were exposed only at low spring tides, and where they were inundated only at high spring tides. Degradation occurred more rapidly in A. marina than in B. gynmorrhiza and leaves constantly submerged decomposed at a faster rate than those exposed for most of the time. Decomposition rates were consistently lower in the cool season. The concentration of nitrogen in all leaves increased over the decomposition period, although there was a decrease in total nitrogen content with rapid decomposition. While under certain conditions degradation proceeds at a rapid rate, because of the lower additions of nitrogen to the system from decomposing leaves, there do not appear to be significant ecological advantages from this rapid decomposition. There were sharp decreases in the phosphorus and potassium contents of the leaves, presumably largely due to leaching. This work has emphasized the importance of mangrove leaf litter as a source of, and substrate for, nutrient release. (Author's abstract)
W88-10850

MEIOBENTHIC GRADIENTS WITH SPECIAL REFERENCE TO PLATYHELMINTHES AND POLYCHAETA IN AN ESTUARINE SALT MARSH CREEK: A SMALL-SCALE MODEL FOR BOREAL TIDAL COASTS,
Biologische Anstalt Helgoland (Germany, F.R.). Litoralstation.
M. Hellwig-Armonies, and W. Armonies.
Helgolaender Meeresuntersuchungen HEMEDC, Vol. 41, No. 2, p 201-216, 1987. 1 fig, 5 tab, 21 ref.

Descriptors: *Wetlands, *Platyhelminthes, *Polychaetes, *Salt marshes, Estuaries, Streams, Benthic fauna, Macroinvertebrates, Nematodes, Copepods, Oligochaetes, Species composition, Sylt Island, North Sea, Estuarine environment.

Environmental conditions in salt marsh creeks are intermediate between the open tidal coast and estuaries. A large salt marsh creek at the island of Sylt (North Sea) was studied in order to test whether its fauna is more similar to that of the open tidal coast or to that of estuaries. Because of a sandy bar at the seaward opening, the tidal range is only 10 cm in the creek, and the water level never drops below the level of the sand bar. Zoobenthos in the sandy bottom and on the sandy shores was studied at both ends and in the middle of the creek. Polychaeta and Platyhelminthes were determined to species level. On an average, 2115 metazoans were found below 10 sq cm of surface area. At the seaward end of the creek, abundance and taxonomic composition are similar to that of the adjoining Wadden area. Nematoda are the dominant taxon, followed by Copepoda, Platyhelminthes and Oligochaeta. Taxonomic composition is different at the landward end. Platyhelminthes and Nematoda are most abundant followed by Copepoda. Both Oligochaeta and Polychaeta are scarce at these newly eroded sites. Platyhelminth abundance at the landward end of the creek is exceptionally high (770-935/sq cm). Contrary to what is generally found in estuaries, the species density of Platyhelminthes shows a significant increase toward the land. The species composition of Polychaeta and Platyhelminthes indicates that the sites below mean high tide level of the creek correspond to the adjacent eulittoral Wadden area while the fauna of the supralittoral sites of the creek is similar to the fauna of supralittoral tidal coasts. Typical sublittoral species did not occur in the salt marsh creek. Thus, salt marsh creeks may be regarded as a small-scale model for the tidal coast. In context with the results obtained, the definition of estuaries is discussed. (Author's abstract)
W88-10851

POLLUTION OF THE SEAS AROUND INDIA,
Department of Ocean Development, New Delhi (India).
For primary bibliographic entry see Field 5C.
W88-10860

BREACHING THE MOUTH OF THE BOT RIVER ESTUARY, SOUTH AFRICA: IMPACT ON ITS BENTHIC MACROFAUNAL COMMUNITIES,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W88-10868

UPTAKE AND RELEASE OF MATERIALS BY A WADDEN SEA MUSSEL BED,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
R. F. Dame, and N. Dankers.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 118, No. 3, p 207-216, June 1988. 3 fig, 1 tab, 28 ref. NSF Grant INT-8521360.

Descriptors: *Estuarine environment, *Nutrients, *Mussels, *Cycling nutrients, *Tidal waters, Biomass, Uptake, Decomposing organic matter, Suspended sediments, The Netherlands, Wadden Sea, Algae, Benthos.

A flow-through plastic tunnel was used to determine the uptake and release of materials in the tidal waters passing over a mussel bed in the western Wadden Sea (Netherlands). There was significant uptake of total suspended sediments (4.4-7.2 g/sq m/h), chlorophyll a (15.4-55.1 mg/sq m/h), total organic C (0.8-1.1 g C/sq m/h), and nitrite + nitrate (0.02-0.08 g N/sq m/h). there was a significant release of ammonium (0.04-0.11 g N/sq m/h) and o-phosphate (0.05-0.08 g P/sq m-h). The intertidal mussel bed removed particulate materials at high rates from the water column, transformed some of this material into biomass and released some constituents as dissolved waste products. Even though the directions of material uptake and release on the mussel bed are similar to oyster reef systems, the magnitudes of material transports are generally higher on the mussel bed due to greater filter-feeder biomass, the existence of a substantial microbenthic algal component and a considerably different environmental setting. (Author's abstract)
W88-10869

STUDY ON WATER QUALITY CHARACTERISTICS AND LONGITUDINAL DISPERSION COEFFICIENT OF SUYEONG ESTUARY, (IN JAPANESE),
Dong-A Univ., Pusan (Korea). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-10897

GEOCHEMISTRY OF INTERSTITIAL WATER FOR A SEDIMENT CORE FROM THE INDIAN RIVER LAGOON, FLORIDA,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 5C.
W88-10899

IMPACT OF THE SALINITY OF SOIL-WATER AND FOOD ON THE PHYSIOLOGY, BEHAVIOUR AND ECOLOGY OF SALT-MARSH COLLEMBOLA,
Vrije Univ., Amsterdam (Netherlands).
J. Witteveen.
Functional Ecology, Vol. 2, No. 1, p 49-55, 1988. 5 fig, 1 tab, 29 ref.

Descriptors: *Insects, *Salt marshes, Collembola, Salinity, Soil water, Osmoregulation, Food habits, Growth, Reproduction.

The impact of salt in soil-water and food on the osmotic and ionic regulation, behavior, growth and reproduction of the salt-marsh dwelling Hypogastrura viatica was investigated. An experimental design was applied in which both factors were considered simultaneously. H. viatica regulated its osmotic concentration at soil-water salinities up to 50% S.W. At higher salinities it was an osmoconformer. Food salinity had no significant effect on the osmotic concentration of the collembolans. Both soil-water and food salinity had an effect on the ionic concentration of the haemolymph. A higher conductivity was measured at higher soil-water and food salinities. Both soil-water and food salinity had a significant effect on growth and reproduction. At higher salinity the collembolans showed a lower feeding activity and consequently a lower growth and reproduction but the effect of the soil-water salinity was stronger than that of the food salinity. At an increasing salinity of the soil-water H. viatica showed a stronger avoidance of food of high salt concentration. (Author's abstract)
W88-10903

PALEOHYDROLOGY OF THE SEDIMENTATION BASIN IN SENEGAL: ESSAY RELATING TO DEPRESSED NAPPES (PALEOHYDROLOGIE DU BASSIN, SEDIMENTAIRE DU SENEGAL: ESSAI D'EXPLICATION DE NAPPES DEPRIMEES),
Public Health Inst. of Slovenia, Lujubijana (Yugoslavia).
For primary bibliographic entry see Field 2F.
W88-10907

TIDALLY INDUCED WATER LEVEL FLUCTUATIONS AS A MEASURE OF DIFFUSIVITY IN A CONFINED AQUIFER -- A GRAPHICAL METHOD,
South Carolina Water Resources Commission, Beaufort.
For primary bibliographic entry see Field 2F.
W88-11100

TIME DOMAIN ELECTROMAGNETIC (TDEM) EXPLORATION FOR CHARACTERIZATION OF INJECTION ZONES AND SALT WATER INTRUSION MAPPING,
Earth Technology Corp., Golden, CO.
For primary bibliographic entry see Field 5B.
W88-11110

NUMERICAL MODELING OF GROUND WATER FLOW AND SALTWATER TRANSPORT IN NORTHERN PINELLAS COUNTY, FLORIDA,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 2F.
W88-11112

SALTWATER ENCROACHMENT STUDY AT HILTON HEAD ISLAND, SOUTH CAROLINA,
South Carolina Water Resources Commission, Beaufort.
For primary bibliographic entry see Field 2F.
W88-11113

STATUS OF SALT WATER INTRUSION IN SOUTH FLORIDA,
Montgomery (James M.) Consulting Engineers, Inc., Lake Worth, FL.
For primary bibliographic entry see Field 2F.
W88-11114

POTENTIAL FOR SALTWATER INTRUSION INTO THE UPPER FLORIDAN AQUIFER, HERNANDO COUNTY, FLORIDA,
Geological Survey, Austin, TX.
For primary bibliographic entry see Field 2F.
W88-11115

SYSTEMS APPROACH TO EVALUATING SALTWATER INTRUSION,
Technos, Inc., Miami, FL.
R. C. Benson, and D. Sharma.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 560-579, 6 fig, 2 tab, 24 ref.

Descriptors: *Planning, *Groundwater management, *Aquifers, *Model studies, *Mathematical models, *Saline water intrusion, Long-term planning, Short-term planning, Water supply development, Monitoring wells.

Effective long- and short-term management of groundwater resources in a coastal environment with saltwater intrusion can be accomplished provided adequate data are available and the proper level of model is selected to match the program requirements. A systems approach for the water resource manager must include the following: (1) careful assessment of the program's long- and short-term objectives, (2) review of existing conditions and data including identification of any data deficiencies and an assessment of data accuracy and reliability, (3) selection of an appropriate 1-, 2-, or 3-dimensional model, (4) specific identification of any additional data requirements, (5) use of an optimum combination of geophysical and other methods to obtain additional data, (6) use of the geophysical data to assist in locating test borings and monitor wells, (7) drilling any needed test borings and carry out hydrologic testing, (8) initial modeling of natural conditions and assessing the impact of various management controls, (9) installing additional monitor wells, (10) long-term monitoring with wells and geophysics, as appropriate, and (11) long-term modeling to essess natural temporal cultural and regulatory changes. Using this general approach, and allowing for interaction and revision as more information and modeling results are produced, will provide a means of effectively converging on an optimum assessment. This systems approach would allow the management of an optimum short-term and long-term use of coastal water resources. (See also W88-11084) (Miller-PTT)
W88-11118

CHESAPEAKE BAY MARINE ENVIRONMENTAL ASSESSMENT: MARCH 1986 - AUGUST 1986,
Maryland Univ. Eastern Shore, Princess Anne. Coastal Ecology Research Lab.
For primary bibliographic entry see Field 2H.
W88-11261

EVALUATION OF SURVEY POSITIONING METHODS FOR NEARSHORE MARINE AND ESTUARINE WATERS.
Tetra Tech, Inc., Bellevue, WA.
For primary bibliographic entry see Field 5A.
W88-11266

LOWER JAMES RIVER CIRCULATION STUDY, VIRGINIA, EVALUATION OF CRANEY ISLAND ENLARGEMENT ALTERNATIVES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5E.
W88-11280

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

ANTI-FOULING SURFACE MODIFICATION FOR LONGER-LIVED MEMBRANES WITH CONSTANT FLUXES AND SELECTIVITIES: AFT II,
Georgia Inst. of Tech., Atlanta.
L. M. Speaker, W. B. Forrister, H. Gao, E. S. K. Chian, and D. P. Campbell.
Available from National Technical Information Service, Springfield, Va 22161 as PB88-235 999/AS. Price codes A07 in paper copy, A01 in microfiche. Final report, April 15, 1988. 138 p, 55 fig, 85 tab, 5 append. USGS 14-08-0001-G1281.

Descriptors: *Desalination, *Membranes, *Fouling, *Reverse osmosis, *Ultrabiltration, *Monomolecular films, *Fluorinated surfactants, Membrane processes, Membrane fouling, Antifouling coatings, Feasibility studies.

The research was conducted to explore the feasibility of mitigating the fouling of ultrafiltration (UF) and reverse osmosis (RO) membranes by modification of the membrane surfaces with oriented monomolecular films of fluorinated surfactants. Monomolecular films were formed by the Langmuir-Blodgett technique on commercially available membranes. Coated membranes were tested at constant pressure while measuring flux using either a stirred 40 psig UF cell or a 250 psig RO cell. It was concluded that the nature of the polar group of the surfactant and its interaction with the substrate are more important than the degree of fluorination of the surfactant in its ability to decrease fouling. The fluorinated surfactant L-10089 (3M Company) was determined to be effective at reducing the fouling propensity of UF and RO membranes. Several polymerizable materials were examined for antifouling properties. Two proved to potentiate fouling when nonpolymerized; after polymerization, the membrane surfaces became highly resistant to fouling. Flux, however was reduced virtually to zero. (USGS)
W88-10101

3B. Water Yield Improvement

PROSPECTS FOR RAINFALL MODIFICATION IN THE EASTERN SOUTH ISLAND, NEW ZEALAND,
Meteorological Service, Wellington (New Zealand).
J. T. Steiner, and D. E. Shaw.
New Zealand Journal of Geology and Geophysics, Vol. 30, No. 1, p 189-194, 3 fig, 2 tab, 17 ref.

Descriptors: *Weather modification, *New Zealand, *Simulation, *Model studies, *Rainfall, *Cloud seeding, Atmospheric water, Statistics, Prediction, Monte Carlo method.

The eastern areas of the South Island of New Zealand have marked rainfall variability. There has been, from time to time, interest in augmenting rainfall by artificial methods. Using recorded rainfall, numerical experiments are conducted to determine by Monte Carlo methods the probability of statistically detecting particular rainfall increases in experiments lasting 5 or 10 years and conducted over the November-April period. A rainfall increase of 30% on seeded occasions would probably be detected but smaller increases might not be identifiable even in 10 years. Restriction of seeding to occasions when there is a large water need has little effect on the probability of detecting effects of seeding. (Author's abstract)
W88-10849

APPLIED GROUND WATER MANAGEMENT MODEL FOR EVALUATING WATER CONSERVATION THROUGH REDUCING PHREATOPHYTE TRANSPIRATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
G. A. Nelson, R. W. Ritzi, S. Sorooshian, and H. Bouwer.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1196-1208, 10 fig, 16 ref.

Descriptors: *Water conservation, *Groundwater management, *Phreatophytes, *Transpiration, *Model studies, Mathematical models, Floodplains, Riparian water loss, Water loss, Rivers, Wells, Evapotranspiration, Aquifers, Transmissivity, Water table.

A mathematical modeling approach was used to evaluate water conservation strategies related to management of the water table below the floodplains supporting phreatophytes. A two-dimensional, finite-difference approach was used to represent the physical system. A management model used these results to perform scenario analysis to determine those factors which are most important in designing a well network. This approach used a nonlinear function of evapotranspiration as a function of depth to water that is based on limited data from the literature. Riparian survivability was ensured by constraining drawdown to the magnitude of maximum root extension and by providing instream flow constraints. Initial results showed that pumpage costs associated with evapotranspiration capture ranged from $3.19 per acre-foot to $16.24 per acre-foot. The distance from the wells to the river was the most important decision variable in the design of the well field. As the distance between the wells and the river increased, the evapotranspiration capture percentage also increased. The additional capture occurred largely in that portion of the aquifer between the wells and the boundary. The model was sensitive to transmissivity values and to the initial depth to water. However, it was not very sensitive to the separation distance between wells. (See also W88-10912) (Cassar-PTT)
W88-10972

USE OF GEOPHYSICAL LOGS IN CONJUNCTION WITH CONCENTRATED ACID INJECTION TO IMPROVE WATER YIELDS FROM LIMESTONE WELLS IN TAMPA, FLORIDA,
CH2M Hill Southeast, Inc., Tampa, FL.
P. L. Waller.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 377-388, 6 fig, 1 tab, 1 ref.

Descriptors: *Well yield, *Well yield improvement, *Groundwater mining, *Well injection, Well logs, Boreholes, Hydrochloric acid, Groundwater storage, Aquifers.

A production test well investigation was completed in Northwest Hillsborough County north of Tampa, Florida.. Seven production wells, 16 - 24 in in diameter, were constructed for the West Coast Regional Water Supply Authority. The wellfield has a capacity of 21 million gallons/day. All wells were constructed as open hole borehole completions into the limestone aquifers. Due to the economic and political constraints, it was necessary to maximize the water production ability of each of the seven wells in order to meet the design water production rate of the total wellfield. A detailed borehole geophysical logging program was done during the construction of the wells to identify the water producing zones intercepted by the boreholes. The detailed logging of each production well showed different locations of water production at each well. This is a common occurrence when dealing with fractured rock. Three of the production wells were acidized with concentrated hydrochloric acid to increase their water production ability. Geophysical logs were used to select individual places in the borehole in which to inject the concentrated acid. This method of acidization places the concentrated acid at the specific fracture intervals where the best results can occur. The wells acidized had improvements in their spe-

cific capacities of 100%. (See also W88-11084) (Author's abstract)
W88-11109

3C. Use Of Water Of Impaired Quality

EFFECTS OF IRRIGATION WITH RAW AND DIFFERENTIALLY DILUTED SEWAGE AND APPLICATION OF PRIMARY SETTLED SEWAGE-SLUDGE ON WHEAT PLANT GROWTH, CROP YIELD, ENZYMATIC CHANGES AND TRACE ELEMENT UPTAKE,
National Environmental Engineering Research Inst., Nagpur (India).
For primary bibliographic entry see Field 5B.
W88-10197

EFFECTS OF LONG-TERM WATER MANAGEMENT IN A HUMID REGION ON SPATIAL VARIABILITY OF SOIL CHEMICAL STATUS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Statistics.
D. B. Marx, J. T. Gilmour, H. D. Scott, and J. A. Ferguson.
Soil Science SOSCAK, Vol. 145, No. 3, p 188-193, March 1988. 3 fig, 3 tab, 20 ref.

Descriptors: *Irrigation effects, *Irrigation water, *Soil genesis, *Soil chemistry, *Water management, Crop production, Soil properties, Precipitation, Calcium carbonate, Rice, Soybeans, Long-term studies, Hydrogen ion concentration, Mapping.

Water-management practices for crop growth require knowledge of the needs of the crop, optimum timing of irrigation applications, and the quality of the irrigation water. To maintain productive soils, the effects of irrigation with poor-quality water on soil properties should be considered. Many studies have recognized the impact of poor-quality water on soil characteristics, yet few have reported on the spatial variability of these soil properties as a response to irrigation in a humid region. Three fields that had been cropped in rice and soybeans in a 3-yr rotations for over 30 yr were sampled for soil pH on a 61.5-m rectangular grid. Spatial variability of pH was quantitatively shown by the construction of linear semivariograms. The pH values were estimated on a 20-m grid using universal kriging of orders 1 and 2, as well as punctual kriging. The resulting kriged values were then plotted as contours of constant pH and compared. The mappings were all similar when compared within a single field, leading to the conclusion that for these data, elimination of drift was not necessary. All observed and mapped values were considerably greater than the pH of uncultivated soil of the region, thus demonstrating a significant accumulation of calcium carbonate in the soil surface due to precipitation from the irrigation water. Higher pH values were observed close to the water inlet, and progressively smaller pH values were seen with increasing distance from the inlet. This spatial distribution clearly followed water-flow patterns and suggested that year-to-year water-management alternatives to reduce localization of calcium carbonate precipitate are desirable within operational limits. (Author's abstract)
W88-10568

FIELD SALINITY PROFILE DEVELOPMENT UNDER DRIP IRRIGATION WITH HIGH-SULFATE WATER,
Agricultural Research Inst., Nicosia (Cyprus).
I. Papadopoulos.
Soil Science SOSCAK, Vol. 145, No. 3, p 201-206, March 1988. 1 fig, 4 tab, 16 ref.

Descriptors: *Irrigation effects, *Drip irrigation, *Saline soils, *Moisture, *Gypsum, Seasonal variation, Leaching, Precipitation, Soil genesis, Gypsum, Sodium absorption, Conductivity.

This field study investigated the buildup of soil salinity and distribution of salts as influenced by gypsum-saturated water (34.5 mol SO4(-)/cu m) applied through a drip-irrigation system and leaching that occurs by winter rains. Amounts of water applied were 50 and 60 l/plant per week in the first and second irrigation seasons, respectively. The soil was a Pellic Vertisol that contained no gypsum. Soil salinity by time, vertical depth, and lateral distance from the emitter was affected by moisture distribution during the irrigation season and leaching by winter rains. With frequent drip irrigation and sufficient leaching during the irrigation season, the highly soluble salts beneath the emitter are maintained at levels comparable to those of the irrigation water. Although highly soluble salts accumulated during the irrigation season, particularly in the soil surface at a lateral distance of 20 to 40 cm from the emitter, they decreased to their initial values after leaching by winter rains. Precipitation of Ca with SO4 as gypsum during the irrigation season was greater than dissolution of gypsum and leaching of these ions deeper in the soil by the 390 mm of winter rains. This resulted in a soil profile saturated with gypsum with a uniform electrical conductivity (EC) of 3 dS /m and Ca and So4 concentration levels of about 30 mol plus or minus /cu m throughout the soil profile in the 0- to 120-cm depth. An increase in soil EC occurred throughout the wetting front, which must be considered the lowest starting salinity for the beginning of each irrigation season. The increase in sodium absorption ratio (SAR) was not at a level to adversely affect the infiltration capacity of the soil. (Author's abstract)
W88-10569

3F. Conservation In Agriculture

MODELING INFILTRATION AND HYDRODYNAMIC EFFECTS ON SURGE FLOW SURFACE IRRIGATION,
Texas Univ. at Austin. Graduate School.
A. W. Blair.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8609465. Ph.D. Dissertation, 1985. 222 p, 62 fig, 23 tab, 53 ref, 10 append.

Descriptors: *Surges, *Surface irrigation, *Surface flow, *Kinematic wave theory, *Infiltration, *Irrigation efficiency, Furrows, Irrigation-return flow, Model studies, Computer programs, Simulation analysis, Mathematical models.

Movement of a surface flow profile over an infiltrating soil under conditions of surge flow was studied with application to surge irrigation systems. The effects of wetted perimeter, furrow geometry, surge flow cycle ratio, and cycle time on infiltration were investigated and modeled. A physical model of an irrigation border was developed and calibrated and a computer model of surge flow irrigation based on the kinematic wave characteristics of flow was developed and verified. The Kostiakov cumulative infiltration equation, modified to include a wetted perimeter raised to a power greater than unity, appeared to satisfactorily represent the effect of wetted perimeter on infiltration in furrows. Hypothetical irrigation simulations indicated that, for some high intake rate soils, surge flow has potential for improving efficiency over conventional continuous irrigation. But the model also indicated that an improperly operated surge flow system can actually have lower efficiency than a continuous flow system. (Cremmins-AEPCO)
W88-10090

IRRIGATION PIPE,
E. Lehto, G. Moller, and L. Sjovall.
U. S. Patent No. 4,577,997; March 25, 1986, 4 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1064, No 4, p 1709, March 25, 1986.

Descriptors: *Patents, *Irrigation pipes, *Pipes, *Subsurface irrigation, Irrigation engineering, Plastics, Conveyance structures, Polymers, Irrigation water.

A subsurface irrigation pipe contains a slit, which is opened under water pressure to discharge the irrigating water. The two-layer irrigating pipe is formed by producing a hot tubular first layer of polyethylene plastic. After the first layer cools, a second layer of polyethylene plastic is applied so that it completely ensheathes the first layer in continuous contact uniformly around the periphery. The slits which traverse these outwardly, so that contaminants within the pipe that are entrained by the irrigating water do not wedge in the slits. (Cremmins-AEPCO)
W88-10102

PRODUCTION OF PVC IRRIGATION PIPE AND THE PIPE SO PRODUCED,
Imperial Chemical Industries Ltd., London (England).
C. Dorrn.
U.S. Patent no. 4,577,998; March 25, 1986, 7 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1064, No 4, 1710, March 25, 1986.

Descriptors: *Patents, *Permeable pipes, *Plastic pipes, *Irrigation pipes, *Pipes, *Irrigation design, Irrigation engineering, Irrigation water, Polymers, Permeability.

Flexible water-permeable pipe produced from a plasticized polyvinyl chloride formulation is suitable for irrigation applications and does not lose its water permeability to an unacceptable extent after prolonged periods of continuous or intermittent use. The PVC formulation contains an aide to enhance melted strength and a chemical blowing agent system. An extruded melt is expanded by foaming it immediately after it leaves the die into a substantially closed cell extrudate of greater outer diameter than the outer diameter of the die exit orifice. The surfaces of the extrudate are substantially unpunctured and the expansion of the extruded melt is into the atmosphere. Drawing down of the extrudate in the atmosphere causes rupturing of the foam cell walls of the extrudate to form an open-cell extrudate having punctured surfaces. When it has been drawn down in the atmosphere to a degree that is prior to any cellular collapse which would lead to the formation of water-impervious pipe, the extrudate is cooled by passing it through a cooling system to prevent any collapse. (Cremmins-AEPCO)
W88-10107

TRENDS IN IRRIGATION DEVELOPMENT, AND THEIR IMPLICATIONS FOR HYDROLOGISTS AND WATER RESOURCES ENGINEERS,
Food and Agriculture Organization of the United Nations, Rome (Italy). Land and Water Development Div.
G. M. Higgins, P. J. Dieleman, and C. L. Abernethy.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 1, p 43-59, February 1988. 8 fig, 7 tab, 5 ref.

Descriptors: *Agriculture, *Water resources development, *Irrigation engineering, *Irrigation effects, *Developing countries, Management planning, Hydrology, Geohydrology, Watersheds, Africa, Irrigation.

Previous rates of expansion of irrigated areas are not being maintained except possibly in Africa. Reasons for this reduction in the rate of new irrigation development include greater availability of agricultural produce, static or even reduced prices, a very high costs of development and maintenance plus severe financial constraints. Concurrently, an increasing number of countries are approaching full development of their surface water resources. This combination of factors dictates new management objectives including: improved system performance, reducing operating costs, increasing production through higher levels of inputs, more emphasis on research and training plus transfer of some operational responsibilities to farmers. Health aspects are likely to assume greater importance as are upstream considerations including watershed hydrology and protection. Key elements to irrigation in Africa have been well identified by the 1986 FAO Consultation on Irrigation in Africa in Lome. (Author's abstract)
W88-10486

EFFECTS OF LONG-TERM WATER MANAGEMENT IN A HUMID REGION ON SPATIAL VARIABILITY OF SOIL CHEMICAL STATUS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Statistics.
For primary bibliographic entry see Field 3C.
W88-10568

FIELD SALINITY PROFILE DEVELOPMENT UNDER DRIP IRRIGATION WITH HIGH-SULFATE WATER,
Agricultural Research Inst., Nicosia (Cyprus).
For primary bibliographic entry see Field 3C.
W88-10569

ESTIMATING IRRIGATION PUMPAGE: LESSONS IN THE VARIABILITY OF INDIVIDUAL WELL PUMPAGE,
Illinois State Water Survey, Champaign. Ground-Water Section.
For primary bibliographic entry see Field 7B.
W88-11037

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

MODULAR DRAIN SYSTEM,
Quaker Plastic Corp., Mountville, PA.
D. E. Dahowski.
U.S. Patent No. 4,490,067; December 25, 1984, 9 p, 20 fig. Official Gazette of the United States Patent Office, Vol 1049, No 4, p 1616, December 25, 1984.

Descriptors: *Patents, *Surface drainage, *Drains, *Drainage systems, Drainage engineering, Construction methods, Concrete construction, Conduits.

Components of a modular drainage system can be designed and essentially prefabricated by selecting and solvent welding them together off site. The components are readily installed and welded or bonded at the connections in situ to provide a watertight system with a minimum of labor. The top of the drain is offset to permit installation of the drain snugly against a wall and to remove water would otherwise collect in corners near it. An alignment color line on one side of the modules facilitates the preassembly of the drainage components. The drain also functions to accommodate the effects of contraction and expansion of concrete slabs and cracks that may form contiguous to the concrete structures in which the drain may be installed. The drain is adapted to be readily aligned and secured on the ground or substrate while concrete is poured. It may be attached to a conventional cylindrical drain pipe to convey accumulated water within the pipe. (Cremmins-AEPCO)
W88-10106

PROCEDURE AND MEANS FOR PROVIDING A VERTICAL DRAIN IN THE BOTTOM OF A WATER BODY,
M. O. Juhola.
U.S. Patent No. 4,428,699; January 31, 1984, 5 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1038, No 5, p 1822, January 31, 1984.

Descriptors: *Patents, *Subsurface drains, *Drainage systems, *Water conveyance, Conveyance structures, Bottom water, Soil water, Drainage engineering, Clays, Mud.

Vertical drainage is used to dewater and drain a clay or mud layer of thicknesses of up to tens of meters on the bottom of a sea or lake. A conveyor on a raft on the surface of the water body moving in a vertical direction is lowered to a depth close to the bottom of the water body. A push tube supported by the conveyor in a vertical direction is pushed into the soil layer on the bottom of the water to a desired depth. The tube carries with it the prefabricated drain, which is provided with an anchor on its lower end. When th push tube is pulled up, the prefabricated drain remains in place in the soil layer with the aid of the anchor. When the push tube is pulled up to a height above the lower end of the conveyor, a second anchor is affixed to the strip drain by a fastener on the lower end of the conveyor. (Cremmins-AEPCO)
W88-10109

DRAINAGE DEVICE,
For primary bibliographic entry see Field 4B.
W88-10111

ALGORITHM FOR SELECTIVE WITHDRAWAL FROM STRATIFIED RESERVOIR,
Western Australia Univ., Nedlands. Centre for Water Research.
G. C. Hocking, B. S. Sherman, and J. C. Patterson.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 707-719, July 1988. 6 fig, 7 ref, appen.

Descriptors: *Selective withdrawal, *Stratification, *Model studies, *Simulation, *Reservoir operation, *Hydrodynamics, Hydrologic models, Algorithms.

A method to simulate withdrawal of water from a stratified water body is introduced. The method can handle large withdrawals within a single time step and therefore allows the use of relatively long time steps, considerably reducing computational expense. Good agreement with the experimental work of other researchers is found. The results of simulations incorporating the algorithm into the dynamic reservoir model DYRESM are shown for Wellington Reservoir in Western Australia. (Author's abstract)
W88-10228

ROLE OF SMALL HYDROELECTRIC STATIONS IN THE RATIONAL USE OF SMALL RIVERS,
A. L. Velikanov, and E. V. Zakachurina.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 108-112, August 1987. 1 fig, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 49-53, February 1987.

Descriptors: *Hydroelectric plants, *Water resources development, *Rivers, *Small hydro, *Multipurpose projects, *Soviet Union, *Hydrological regime, *River flow, *Regulated flow, Low flow, Flood flow, Flow discharge, River basin development, Hydraulic design, Design criteria.

Since small rivers in the Soviet Union account for 95% of the drainage system, they play an important part in water supply management. The majority of small rivers have a nonuniform regime in which almost the entire annual runoff occurs during a short spring period, after which ensues a low flow. The creation of regulating hydro developments makes it possible to increase the low-stream flows, thus increasing their sanitary flow and improving their ecological state. The mass construction on small rivers of multipurpose water-management complexes should be preceded by the solution of a number of complex problems of a hydrological, ecological, technical, and economic character. A modern system for studying the runoff of small rivers is needed, including low flow, normal annual discharge and maximum flood discharge data. The latter two parameters are the most important characteristics when selecting the energy parameters, design, and most efficient operation of a small hydroelectric station. The construction of small hydrostations as part of multipurpose water-management systems is planned on the basis of technical and economic calculations with consideration of the requirements of all participants of the complex. (VerNooy-PTT)
W88-10433

EFFECTS OF VEGETATION REMOVAL BY GRASS CARP AND HERBICIDES ON THE WATER CHEMISTRY OF FOUR FLORIDA LAKES,
Rollins Coll., Winter Park, FL. Dept. of Biology.
J. W. Small, D. I. Richard, and J. A. Osborne.
Freshwater Biology FWBLAB, Vol. 15, No. 5, p 587-596, October 1985. 1 fig, 5 tab, 30 ref.

Descriptors: *Aquatic weed control, *Water quality, *Aquatic plants, *Herbicides, *Grass carp, *Lakes, Florida, Aquatic weeds, *Dissolved oxygen, Alkalinity, Storm runoff, Conductivity, Turbidity, Chlorophyll.

Four lakes in central Florida each received a different weed control treatment consisting of herbicide and/or different stocking ratios of grass carp (Ctenopharyngodon idella Val.). Submersed vegetation was eliminated by grass carp within 6 months in Lake Orienta and within 14 months in Clear Lake. Because Little Lake Fairview, treated with herbicide and a smaller stocking ratio of grass carp, retained abundant vegetation levels over the first two study years, grass carp which had been introduced initially were replaced with a greater number of fish at the beginning of the third year. Submersed vegetation was subsequently eliminated in this lake within 10 months. Aquatic vegetation was reduced but not eliminated in Lake Mann which was treated with herbicide only. Where macrophytes were removed there tended to be increased bottom dissolved oxygen, higher and more stable total alkalinity values, increased turbidity, lowered transparency, higher specific conductivity and increased chlorophyll levels. Significant increases in pH were probably due to low water levels resulting from a severe drought rather than weed control. Low water also affected specific conductivity. Annual means for nutrients did not differ significantly between years in the four lakes. (Author's abstract)
W88-10686

EARTH OVERFLOW DAM,
For primary bibliographic entry see Field 8A.
W88-10879

4B. Groundwater Management

DEVICE FOR PREPARING AND CLEANING TRENCH FOR AN AQUIFER RECHARGING SYSTEM,
E. H. Lacey.
U. S. Patent No. 4,337,006; June 29, 1982, 12 p, 15 fig. Official Gazette of the United States Patent Office, Vol 1019, No 5, p 1721, June 29, 1982.

Descriptors: *Artificial recharge, *Patents, *Impervious membranes, *Trenches, *Aquifers, *Groundwater recharge, *Recharge, Cleaning, Filter media, Irrigation water, Municipal water, Aquifer systems.

An aquifer recharging system consists of lining a trench on one or both walls with a membrane impervious to water so that water can be confined either in a specific place or outside of a certain space. The system, which may be used in conjunction with a trencher, requires no separate power source, although it may also be used separately. A container is attached to a carrying system and adapted to extend downward into the trench. A support in the container is adapted to support at least one roll fo the membrane on a vertical axis. The container contains sides and a rear wall, which cooperates to form at least one slot through which the membrane can be unrolled from the roll and lie against the wall of the trench. The system also includes a method for cleaning an aquifer recharging filter bed. (Cremmins-AEPCO)
W88-10103

SUB-SOIL DRAINAGE PIPING,
Kothmann (Antonius B.), Somerset West (South Africa).
A. B. Kothmann, and K. Brinch.
U. S. Patent No. 4,626,129; December 2, 1986, 4 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1073, No 1, p 289, December 2, 1986.

Descriptors: *Patents, *Pipes, *Subsurface drains, *Subsoil drains, *Drainage engineering, Drainage systems.

Subsurface drainage piping sections contain connectors at both ends. The piping can be interconnected end-to-end to form a subsurface drainage line. Circumferentially spaced, longitudinally extending slots make the piping water pervious. The connecting formations are complementary spigots and sockets. The spigot of one pipe segment is receivable in a socket in another segment. Each slot is open across its entire width longitudinally in the direction of the socket. The piping may comprise a first round cylindrical portion integral with an extending from the first cylindrical portion to the other end of the segment. The inside diameter of the first portion is equal to or slightly greater than the outside diameter of the second portion. The length of the piping is less than twice the outside diameter of the second cylindrical portion. Each slot is defined by a pair of longitudinally extending walls which diverge from the outside of the segment inwardly. (Cremmins-AEPCO)
W88-10105

PROCEDURE AND MEANS FOR PROVIDING A VERTICAL DRAIN IN THE BOTTOM OF A WATER BODY,
For primary bibliographic entry see Field 4A.
W88-10109

DRAINAGE DEVICE,
J. Glasser.
U.S. Patent No. 4,490,072; December 25, 1984, 3 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1049, No 4, p 1616, December 25, 1984.

Descriptors: *Patents, *Drainage systems, *Subsurface drainage, *Pipes, Conveyance structures, Drainage engineering, Water conveyance, Plastics.

A drainage pipe below a core surrounded by a groundwater pervious material, which provides a pathway for the water through the core and into the pipe, is assembled with an improved nonwoven filter material. The elongated drain pipe defines axially spaced radially outwardly extending portions, which provide annular valleys in between. The valleys communicate with openings in the sidewall of the pipe to provide passageways for the water. A rectangular plastic core sheet contains opposing sides with alternately raised land portions and surrounding valleys of corresponding configuration. The sheet is arranged tangentially to the pipe so that the land portions contact the raised annular portions of the pipe. The sheet is impervious to groundwater, but defines passageways around the raised land portions for water to flow into the surrounding valleys along its non-woven plastic sheet material is wrapped around both the core sheet and the pipe to prevent the surrounding fill material from plugging the passageways when drainage device is installed in a subterranean system to drain groundwater from the surrounding fill. (Cremmins-AEPCO)
W88-10111

AQUIFER RESTORATION: CHLORINATED ORGANICS REMOVAL CONSIDERATIONS IN PROVEN VS INNOVATIVE TECHNOLOGIES,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5G.
W88-10408

ANALYSIS OF SUSTAINED GROUND-WATER WITHDRAWALS BY THE COMBINED SIMULATION-OPTIMIZATION APPROACH,
Alberta Environment, Edmonton. Earth Sciences Div.
For primary bibliographic entry see Field 2F.
W88-10419

PROCEEDINGS OF THE NWWA CONFERENCE ON SOLVING GROUND WATER PROBLEMS WITH MODELS.
For primary bibliographic entry see Field 2F.

W88-10912

TECHNOLOGY TRANSFER IN GROUNDWATER MODELING: THE ROLE OF THE INTERNATIONAL GROUND WATER MODELING CENTER,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
P. K. M. van der Heijde.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1-8, 1 fig, 4 ref. EPA Cooperative Agreement CR-812603.

Descriptors: *Groundwater management, *Model studies, *Information exchange, International Ground Water Modeling Center, Holcomb Research Institute, Documentation, Computer models, Mathematical models, Education, Training, Computer programs, Quality control, Technology transfer.

The International Ground Water Modeling Center was established in 1978 at the Holcomb Research Institute, Indianapolis, Indiana, to advance the use of modeling methodologies by regulatory and management agencies in the development of effective ground water management procedures. The organization has developed an extensive technology transfer, research, and assistance program which includes dissemination of information about the modeling process and the role of modeling in groundwater resource management; model availability; development of selection and testing procedures; promotion of quality assurance in the application of groundwater modeling software, acquisition and distribution of models, supporting software, and documentation; education of model users, managers, and teachers; and publication of a newsletter. International activities are handled in the office at Delft, The Netherlands. (See also W88-10913) (Cassar-PTT)
W88-10913

DEVELOPMENT OF QUANTITY AND QUALITY MODEL FOR OPTIMAL GROUNDWATER MANAGEMENT,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W88-10922

GROUND WATER HYDROLOGY AND WATER LAW: BRIDGING THE GAP WITH MODELS,
C. Kraeger-Rovey.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 217-229, 4 fig, 7 ref.

Descriptors: *Groundwater management, *Groundwater movement, *Water law, *Model studies, Regulations, Mathematical models, Denver Basin, Colorado, Legislation, Permits, Well permits, Water supply, Tributaries, Water table, Aquifer characteristics, Geohydrology.

Senate Bill 5 enacted by the Colorado State Legislature was designed to establish a formal definition of non-tributary groundwater and clarify requirements and procedures for obtaining permits for non-tributary wells. This bill has special provisions for defining non-tributary groundwater in the Denver Basin, in which supplies are significantly stressed in the non-renewable aquifer. The bill assumes water table conditions throughout each aquifer for purposes of determining areas of non-tributary groundwater. However, the real hydrologic conditions in the basin do not reflect the conditions described in the bill. No agreement has yet been reached on the best modeling techniques for this situation. Some suggestions are as follows: (1) compare the use of models with altered geometry (change models) and those with realistic geometry (head models); (2) modify the wording of the Senate bill to allow for the use of head modeling; (3) organize a data collection and compilation effort; and (4) use technical advisers during formulation of legislation. (See also W88-10912) (Cassar-PTT)

W88-10924

USE OF THREE-DIMENSIONAL MODELING IN THE MANAGEMENT OF A GROUND WATER SYSTEM RELYING ON INDUCED RECHARGE,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
D. S. Cherkauer, E. R. Rothschild, A. J. Pirelli, and B. D. Henkel.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 541-575, 21 fig, 3 tab, 4 ref.

Descriptors: *Unconsolidated aquifers, *Groundwater management, *Groundwater movement, *Recharge, *Model studies, Artificial recharge, Mathematical models, Dayton, Ohio, Wells, Hydraulic conductivity, MODFLOW model, Dredging, Pumping, Aquifers, Alluvial aquifers, Shallow aquifers, Infiltration, Wells, Management planning.

A complex hydrogeologic system of two unconsolidated aquifers (shallow and deep, separated by a discontinuous till aquitard) serving as the water supply for Dayton, Ohio, was modeled as a three-dimensional system using MODFLOW. The goal of the study was to assess the possibility of expanding pumpage at the Mad River Well Field from 43 to 93 mgd by the year 2010. Five areas for water development were considered, as well as the three sources of water at each site: deep aquifer, shallow aquifer, and induced recharge to the shallow aquifer. Four development scenarios were considered at each site. These included pumping in the shallow aquifer with no additional dredging, pumping the shallow aquifer in the presence of additional dredging, pumping the deep aquifer only, and a combination of the latter two. The model provided the following information: (1) availability of water under several politically feasible expansions; (2) the most viable combination of possible expansions which will produce a sufficient supply; (3) the potential for degradation of the water supply from proposed expansion; (4) the importance of induced recharge and proper maintenance by dredging of the infiltration lagoons. (See also W88-10912) (Cassar-PTT)
W88-10940

APPLICATION OF A QUASI-THREE-DIMENSIONAL FLOW MODEL,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
A. Das Gupta.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 590-610, 14 fig, 6 tab, 16 ref.

Descriptors: *Groundwater movement, *Management planning, *Groundwater management, *Thailand, *Model studies, Bangkok, Mathematical models, Water supply, Pumping, Wells, Subsidence, Water demand, Simulation, Water table.

Future groundwater flow in the lower central plain of Thailand (Bangkok region) was modeled with a quasi-three-dimensional flow model which had been modified to suit the local hydrogeologic conditions. The subsurface was considered to be a single hydraulically connected body stratified into model layers for convenience in the simulation. Six pumping scenarios were devised based on the expected future demand of water, the possibility of expansion of public water supply derived from surface water, and controlling measures such as regulation of well spacing and depth of pumping to minimize subsidence. The plan calling for complete phaseout of pumpage by the year 2000 was considered the best, with a maximum potentiometric drop below mean sea level of less than 15 m in the depth zone 100-200 m. Increasing pumpage from the 1979 level of 1.2 million cu m/d to 3 million cu m/d by year 2000 would produce a potentiometric drop of 100-115 min the same depth zone. Other pumpage plans produced drops of 15 to 70 m. (See also W88-10912) (Cassar-PTT)
W88-10942

PREDICTING FUTURE GROUND WATER LEVELS WITH CONFIDENCE,
Brown and Caldwell, Atlanta, GA.
M. J. Palilla, and J. E. Salo.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1007-1021, 7 fig, 1 tab.

Descriptors: *Groundwater management, *Groundwater movement, *Wells, *Water level, *Model studies, Mathematical models, San Joaquin County, California, Hydrographs, Water supply, Aquifers, Saline water intrusion, Costs, Consumptive use, PLASM model, Regional planning, Prediction, Water demand.

The Eastern San Joaquin County Ground Water Study, completed in October 1985, was designed to determine the effects that future water supply alternatives would have on the groundwater basin. Several alternatives involving a combined use of groundwater and surface water were evaluated to determine future changes in groundwater levels, the potential for easterly movement of a saline groundwater front, and future water costs. The model used for evaluation was PLASM (Prickett-Lonnquist Aquifer Simulation Model). Comparison of computed water levels with historic water levels using hydrographs, contour maps, and statistics showed that a reasonable match was produced when the average mean difference between computed and historic water levels was near ten feet. This predictive ability was found to lie well within the accuracy needed to make comparisons of future water supply conditions on the basis of changes in water levels. (See also W88-10912) (Cassar-PTT)
W88-10962

METHODOLOGY AND USE OF INTERFACING REGIONAL AND SUBREGIONAL GROUND WATER FLOW MODELS,
Geological Survey, Trenton, NJ.
M. Martin.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1022-1038, 8 fig, 5 ref.

Descriptors: *Regional planning, *Groundwater management, *Groundwater movement, *Atlantic Coastal Plain, *Model studies, Coastal plains, Mathematical models, Regional planning, Regional Aquifer-System Analysis program, Aquifers, Water supply, New Jersey Coastal Plain, Simulation, New Jersey.

A methodology was developed to simulate groundwater flow in 10 aquifers of the northern Atlantic Coastal Plain. Four subregional models were calibrated to simulate flow in New Jersey, Maryland and Delaware, Virginia, and North Carolina. These models were interfaced with a regional model that covers the Atlantic Coastal Plain from Long Island, New York, through North Carolina. Interfacing the subregional models with each other and with the regional model required the transfer of aquifer and confining-unit properties between models during calibration. Flows calculated by the regional model were used as estimates of lateral boundary flows in the subregional models. Aquifer and confining-unit properties in the regional model, and boundary flows in the subregional models, were updated regularly during calibration to insure compatibility of results among the models. The regional model shows the same general patterns of head distribution and flow as those of the subregional models, except for differences that result from scale dependence. Scale dependence generally results in underestimation of boundary flows near regional cones of depression. Flow boundaries should not be near areas of high withdrawals or near other areas where simulated regional water levels differ greatly form simulated subregional water levels because of scale dependence. Sensitivity of simulated heads to boundary flows varies among the subregional models. A sensitivity analysis that uses the New Jersey subregional model shows that large changes in water levels, caused by increasing boundary flows an order of magnitude, dissipated within several nodes of the flow boundary, and water levels throughout most of the modeled area changed less than 10 feet. In three areas of the New Jersey Coastal Plain, a more detailed analysis of flow will be accomplished by interfacing three detailed models covering parts of the New Jersey Coastal Plain with the New Jersey subregional model. In areas where the hydrogeologic data base or framework has not been revised, initial estimates of aquifer and confining-unit properties derived from the calibrated subregional model will be used. (See also W88-10912) (Author's abstract)
W88-10963

FORT HUACHUCA GROUND WATER MODELING STUDY,
Army Engineer District, Los Angeles, CA.
B. G. Bigornia, and A. C. Amar.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1121-1142, 6 fig, 1 tab, 8 ref.

Descriptors: *Groundwater management, *Groundwater movement, *Groundwater level, Model studies, Mathematical models, Water supply, Wells, Fort Huachuca, Sierra Vista, Arizona, Hydrologic budget, Water table.

A modular three-dimensional finite-difference groundwater flow model, developed by McDonald and Harbaugh, was used to analyze the groundwater system and to predict future groundwater levels at the Fort Huachuca Military Reservation, Arizona. Results indicate that, at current withdrawal rates, the groundwater table in the vicinity of the fort is expected to decline at the rate of about 2.3 feet per year. A scenario of increased population growth of Sierra-Vista-Fort Huachuca would further accelerate the rate of decline to about 2.7 feet per year. Furthermore, the model predicts that continuous pumping operations at Fort Well No. 1 will be adversely affected by the year 2030, based on current withdrawal rates. Although the regional aquifer drawdown is less than 1 ft per year, overall groundwater withdrawals are exceeding the safe yield. The problem of low water tables and dry wells could be avoided by redistributing the Fort's groundwater withdrawal. Use of the pumping wells in the East Range would reduce the stress on the water table near the Fort and would still provide the Fort the same quantity of water. These wells are located beyond the zone of influence at current or anticipated withdrawal rates around the area. It is also suggested that proposed development at Sierra Vista should be carefully reviewed to protect the groundwater pumping at the Fort. A monitoring program using observation wells should be established to provide information on water conditions. (See also W88-10912) (Cassar-PTT)
W88-10968

EVALUATION OF PRESSURE RELIEF WELL SYSTEM PERFORMANCE USING A NUMERICAL GROUND WATER FLOW MODEL,
Woodward-Clyde Consultants, Overland Park, KS.
J. D. Ritchey, J. E. Struder, and K. A. Pennybaker.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1175-1195, 7 fig, 2 tab, 9 ref.

Descriptors: *Relief wells, *Groundwater management, *Wells, *Soil water, *Model studies, Mathematical models, Flood protection, Levees, Design floods, Foundations, Soil stability, Hydrostatic pressure, Missouri River, Kansas City, Kansas, Foundations, Dam foundations, Performance evaluation.

A method was developed to evaluate relief well system performance, to forecast relief well placement, and to determine relief well treatment and replacement schedules. These relief wells are designed to relieve hydrostatic pressure in the vicinity of flood protection levees and dams. The method was applied to the 193 relief wells in the Missouri River floodplain in Kansas City, Kansas. The area was divided into 15 reaches based on aquifer properties. Fifteen models were constructed, one for each reach. Each model grid had a uniform spacing of 10 feet per cell to facilitate resolution of head distribution between relief wells. Through simulation of a design flood, this method successfully and systematically located areas along the levee that are susceptible to foundation soil movement. (See also W88-10912) (Cassar-PTT)
W88-10971

APPLIED GROUND WATER MANAGEMENT MODEL FOR EVALUATING WATER CONSERVATION THROUGH REDUCING PHREATOPHYTE TRANSPIRATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 3B.
W88-10972

DRAINMOD: A WATER TABLE MANAGEMENT SIMULATION MODEL,
Ohio Agricultural Research and Development Center, Wooster. Dept. of Agricultural Engineering.
E. Desmond, and K. Konyha.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1335-1344, 1 fig, 23 ref.

Descriptors: *Groundwater management, *Groundwater movement, *Water table, *Drainage, *Soil water, *Model studies, Agriculture, DRAINMOD model, Mathematical models, Irrigation, Subsurface drainage, Subsurface irrigation, Soil properties, Computer models, Simulation.

DRAINMOD, a computer simulation program, is a shallow water table prediction model. An hourly water mass balance is performed for a period over which weather records are available, typically 20 or more years. The model incorporates physical and conceptual techniques to account for precipitation, infiltration, surface and subsurface drainage and irrigation, and evapotranspiration. DRAINMOD is not constrained to agricultural applications and can be applied to natural drainage conditions. DRAINMOD has been used with success internationally for a water table prediction. DRAINMOD may be run on an IBM-PC or IBM-PC compatible with at least 256K memory. A numerical coprocessor is strongly recommended to reduce simulation time. (See also W88-10912) (Author's abstract)
W88-10978

NEW ANNOTATION DATABASE FOR GROUND WATER MODELS,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
P. K. M. van der Heijde, and S. A. Williams.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1475-1495, 2 fig, 6 ref, 1 append.

Descriptors: *Groundwater management, *Groundwater movement, *Model studies, *Data storage and retrieval, *Information exchange, Documentation, Computer models, Mathematical models, International Ground Water Modeling Center, DATATRIEVE database, MARS database.

The International Ground Water Modeling Center, which maintains a clearinghouse for information on groundwater models, has renovated the structure of its annotation database for groundwater models. New features of the database include sections on optimization models, stochastic methods, parameter identification models, hydrochemical models,and data processing programs. The new database also incorporates more complete descriptions of the mechanics of models with sections on model development, solution techniques, boundary conditions, and specific hardware and software requirements. The system is organized in a modular format within a two-tiered hierarchial struc-

ture. This structure, which should facilitate accessibility to the database, is amenable to additions or modifications. The MARS (Model Annotation and Retrieval System) database, started in 1978, was reorganized in 1982 under the DATATRIEVE database. It is scheduled to be placed under the RBASE system V environment, which offers many advantages over the previous system. The appendix shows the details of the information included in the system. (See also W88-10912) (Cassar-PTT)
W88-10987

PROCEEDINGS OF THE NWWA FOCUS CONFERENCE ON MIDWESTERN GROUND WATER ISSUES.
For primary bibliographic entry see Field 2F.
W88-11031

COORDINATION OF LOCAL, STATE, AND FEDERAL AGENCIES' RESPONSE TO GROUNDWATER CONTAMINATION EPISODES,
Elkhart County Health Dept., IN. Environmental Health Div.
For primary bibliographic entry see Field 6E.
W88-11032

ANALYSIS OF WATERWELL CONTAMINATION CASE HISTORIES,
Indiana Dept. of Environmental Management, Indianapolis. Ground Water Section.
For primary bibliographic entry see Field 5B.
W88-11033

NEW WISCONSIN GROUND WATER CENTER TACKLES NON-POINT SOURCE CONTAMINATION WITH EDUCATION,
Wisconsin Univ.-Stevens Point.
T. J. Osborne, C. Mechenich, and B. H. Shaw.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 37-58, 8 fig, 2 tab, 28 ref.

Descriptors: *Groundwater management, *Water pollution sources, *Nonpoint pollution sources, *Groundwater pollution, *Education, *Wisconsin, Pesticides, Nitrates, Agricultural runoff, Domestic wastes, Water sampling, Information systems, Hydraulic models, Recharge.

Widespread groundwater contamination from pesticides and nitrates attributed to agricultural and residential sources has been discovered in Central Wisconsin in the past 10 years in spite of the general lack of violation of specific codes or known misuse of products. The Central Wisconsin Groundwater Center was created in 1985 in response to public concern over groundwater contamination. The staff of the new Center consists of a groundwater-education specialist, a data-management specialist, a secretary, and a hydrogeologist-director. Programs established by the Center to address non-point-source contamination include (a) homeowner drinking-water sampling and education programs; (b) a multi-agency computerized geographic information system for soils, land-use, and groundwater data overlaying; (c) teaching with the aid of a physical sand-tank flow model; (d) groundwater-education programs for local public officials and professionals; and (e) municipal well-recharge-area identification and protection efforts. (See also W88-11031) (Author's abstract)
W88-11034

COMPUTERIZED DATA BASES FOR GROUND WATER MANAGEMENT: THE SOUTHWEST MICHIGAN GROUND WATER PROGRAM,
Western Michigan Univ., Kalamazoo.
D. J. Brown.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 59-70, 2 fig, 2 tab, 5 ref.

Descriptors: *Data storage and retrieval, *Data bases, *Groundwater management, *Hydrologic data collections, *Computers, Michigan, Water quality control, Geology, Aquifer systems, Recharge, Groundwater pollution, Inorganic compounds, Hydrogen ion concentration, Conductance, Organic compounds, Herbicides, Pesticides, Interagency cooperation, Data processing, Land use, Aquifer management, Resources management, Public health, Aquifer characteristics.

The Southwest Michigan Groundwater Survey and Monitoring Program has developed, tested, and instituted in local county health departments a computerized data-management system designed to manage groundwater as a local resource and protect water quality. Local geologic information is obtained from well-drilling records and coordinated with existing geologic studies to define local aquifer systems. Wells are selected to characterize the recharge, transition, and discharge regions of the aquifer. Water-quality information is obtained from analysis for thirty-two inorganic substances, and for pH, conductance, and other characteristics. Typically about four hundred sites per county are to be thus characterized, with about eighty further subjected to testing for representative organic contaminants, herbicides, and pesticides. County health-department staff are trained in computerized data-system management and in applications of geologic cross-section, graphic-display, and groundwater-modeling programs as well as in uploading to and downloading from a mainframe data bank. Application of the databases to land-use planning, aquifer protection, and water-resource management are prime concerns of the program. An ultimate goal is to relate drinking-water quality to public-health profiles on a regional basis. (See also W88-11031) (Author's abstract)
W88-11035

DATA BASE DESIGN FOR A REGIONAL GROUND WATER QUANTITY ASSESSMENT IN KANKAKEE AND NORTHERN IROQUOIS COUNTIES, ILLINOIS,
Illinois State Water Survey, Champaign. Ground-Water Section.
M. A. Collins, and S. J. Cravens.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 71-80, 2 fig, 2 tab, 4 ref.

Descriptors: *Data bases, *Groundwater management, *Data storage and retrieval, *Regional analysis, *Water supply, Illinois, Indiana, Irrigation, Irrigation effects, Pumpage, Aquifer management, Computers, Data processing, Computer models, Information systems, Computer programs, Geographic information systems.

Extensive irrigation development has occurred in Kankakee and northern Iroquois Counties, Illinois. These counties border Jasper and Newton Counties, Indiana, which have been the site of a water-rights conflict resulting in litigation and legislation in that state. An assessment of the groundwater resources in the Kankakee-Iroquois county area has been initiated to examine the effects of Illinois pumpage on the aquifer system, to investigate complaints of domestic water-supply interruption, and to prepare for potential cooperative study and management of the system with Indiana. The database-design process involved matching the hardware environment with the demands implied by the type, structure, and intended uses of the data. Both tabular and mapped data are to be managed. The following general uses for the data have been identified: analysis by subsetting through data relations; bi-directional data transfers for model pre- and post-processing; and display of a variety of combinations of datapoint locations, mapped data interpretations, and base maps. A geographic information system is being used to fulfill these functions. The computing environment is PC-based, but also relies on mainframe hardware and software capabilities. (See also W88-11031) (Author's abstract)
W88-11036

ESTIMATING IRRIGATION PUMPAGE: LESSONS IN THE VARIABILITY OF INDIVIDUAL WELL PUMPAGE,
Illinois State Water Survey, Champaign. Ground-Water Section.
For primary bibliographic entry see Field 7B.
W88-11037

INDIANA CODE 13-2-2.5: WATER RIGHTS IN INDIANA,
Indiana State Dept. of Natural Resources, Indianapolis.
M. E. Basch.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 117-120.

Descriptors: *Groundwater management, *Water law, *Water rights, *Well regulations, *Indiana, Water users, Wells, Drawdown, Pumpage, Standards, Water resources development, Legislation.

With the enactment of Indiana Code 13-2-2.5 by the 1985 Indiana General Assembly, owners of small-capacity water wells (having the pump capacity of less than 70 gallons per minute) are protected from substantial drawdowns caused by pumpage from nearby high-capacity wells. This law provides protection for all properly-functioning domestic wells constructed prior to January 1, 1986. An individual who has a new well constructed after this date and wants to have protection under the law, must have their well installed in accordance with specific recommended well-construction guidelines. Since the law became effective September 1, 1985, the Indiana Department of Natural Resources, Division of Water, has investigated nearly 30 complaints from domestic-well owners who believed their water supplies had been affected by high-capacity groundwater pumpage. Even though domestic-well owners now have some protection against the impacts caused by large-capacity users, the intent of I.C. 13-2-2.5 is not to restrict the development of Indiana's water resource. The law attempts to strike a balance between the interests of both high-capacity and small-capacity groundwater users. (See also W88-11031) (Author's abstract)
W88-11039

HYDROGEOLOGICAL EVALUATION OF GROUNDWATER RESOURCES IN BURIED BEDROCK VALLEYS, NORTHEASTERN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 2F.
W88-11041

GROUND WATER PROTECTION PLANNING USING THE ERDAS GEOGRAPHIC INFORMATION SYSTEM: AUTOMATION OF DRASTIC AND TIME-RELATED CAPTURE ZONES,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5G.
W88-11053

WELL CONSTRUCTION TECHNIQUES TO PREVENT INTERAQUIFIER MOVEMENT OF PESTICIDES,
CH2M Hill, Tampa, FL.
For primary bibliographic entry see Field 8A.
W88-11089

MODEL FOR MANAGEMENT OF LOCAL GROUND WATER SUPPLIES -- MOUNTAIN VALLEY SPRING,
Arkansas Univ., Fayetteville. Dept. of Geology.
K. F. Steele, and L. E. Mack.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 97-107, 2 fig, 2 tab, 14 ref.

Descriptors: *Planning, *Groundwater management, *Model studies, *Hydrologic models, Geologic mapping, Valley springs, Springs, Mountain Valley Springs, Soil properties, Groundwater recharge, Water quality, Rural areas. Water supply development, Groundwater movement.

The management of ground water is complex and should be based on geologic, hydrologic, environmental, economic, legal, political and financial considerations. In order to protect and maintain the quantity and quality of local groundwater supplies, these factors should be considered prior to development. The geologic and hydrologic investigation of Mountain Valley Spring is used as an example of the type of information that should be obtained before development of a local, rural groundwater supply. The major factors to be considered are: (1) stratigraphy, (2) structure, (3) soil types and thickness, (4) porosity and permeability of the rocks and soil, (5) age and chemistry of the groundwater, (6) location of the recharge and discharge areas, (7) direction and rate of groundwater flow, (8) seasonal and storm event effects on recharge and discharge rates and on water quality, (9) amount of water in storage, and (10) landuse. Small rural groundwater supplies must have geologic and hydrologic information to choose the best production site for a groundwater supply and to manage the quantity and quality of the water most effectively. Age of the spring water (about 3500 years) and the forested drainage basin protect the rate of discharge and quality of the spring water and make Mountain Valley Spring an ideal example. (See also W88-11084) (Miller-PTT)
W88-11092

LANDFILL LEACHATE MIGRATION IN FLORIDA'S SURFICIAL AQUIFER SYSTEM,
Northwest Florida Water Management District, Tallahassee.
For primary bibliographic entry see Field 5B.
W88-11096

MANAGEMENT OF WATER USE IN SOUTH FLORIDA -- PROBLEMS AND SOLUTIONS,
South Florida Water Management District, West Palm Beach.
L. A. Wedderburn.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 185-197, 2 fig, 7 ref.

Descriptors: *Florida, *Permits, *Groundwater management, *Water management, *Legislation, *Regulations, Surface water, *Water use, Consumptive use, Hydrology, Aquifer systems, Public policy, Geohydrology.

Water management in South Florida is carried out under the general umbrella of the Water Resources Act, Chapter 373, Florida Statutes. The legislative intent of this statute is implemented through water use and well construction rules which form a part of the Florida Administrative Code. This legislative framework establishes water rights through a permitting system for uses which are reasonable and beneficial, in the public interest and which do not create adverse impacts on existing legal uses. The South Florida Water Management District has issued more than 1850 Water Use permits since implementation of Chapter 373. The major problems encountered in the regulatory process involve definition of an acceptable level of risk, prediction of impacts as a result of allocations, monitoring of withdrawals and enforcement of permit conditions, determination of the limits of allocable water from source aquifers and surface water systems, determination and prediction of cumulative impacts of allocations, and water shortage management. As demands continue to increase towards the limits of available supply, the District has applied more sophisticated methods in the review of permit applications, including computer modelling of local and regional cumulative impacts and detailed determinations of crop requirements. Demand management has been implemented where practical through permit requirements. Studies continue on ways to more effectively monitor agricultural water use and to enforce permit compliance and water shortage restrictions on agricultural users. Additional work remains to be done on determining the optimum drought frequency to be used for allocations, establishing priorities among competing users, and regulating the impacts of ground water withdrawals on wetlands and other surface water bodies. (See also W88-11084) (Author's abstract)
W88-11097

USE OF GEOPHYSICAL LOGS IN CONJUNCTION WITH CONCENTRATED ACID INJECTION TO IMPROVE WATER YIELDS FROM LIMESTONE WELLS IN TAMPA, FLORIDA,
CH2M Hill Southeast, Inc., Tampa, FL.
For primary bibliographic entry see Field 3B.
W88-11109

NUMERICAL MODELING OF GROUND WATER FLOW AND SALTWATER TRANSPORT IN NORTHERN PINELLAS COUNTY, FLORIDA,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 2F.
W88-11112

SALTWATER ENCROACHMENT STUDY AT HILTON HEAD ISLAND, SOUTH CAROLINA,
South Carolina Water Resources Commission, Beaufort.
For primary bibliographic entry see Field 2F.
W88-11113

STATUS OF SALT WATER INTRUSION IN SOUTH FLORIDA,
Montgomery (James M.) Consulting Engineers, Inc., Lake Worth, FL.
For primary bibliographic entry see Field 2F.
W88-11114

POTENTIAL FOR SALTWATER INTRUSION INTO THE UPPER FLORIDAN AQUIFER, HERNANDO COUNTY, FLORIDA,
Geological Survey, Austin, TX.
For primary bibliographic entry see Field 2F.
W88-11115

PREVENTION OF SALTWATER INTRUSION THROUGH ARTIFICIAL RECHARGE OF GROUND WATER IN EAST ORANGE COUNTY, FLORIDA,
Dyer, Riddle, Mills and Precourt, Inc., Orlando, FL.
For primary bibliographic entry see Field 5G.
W88-11116

SYSTEMS APPROACH TO EVALUATING SALTWATER INTRUSION,
Technos, Inc., Miami, FL.
For primary bibliographic entry see Field 2L.
W88-11118

PROCEEDINGS TO THE NWWA FOCUS CONFERENCE ON NORTHWESTERN GROUND WATER ISSUES.
For primary bibliographic entry see Field 2F.
W88-11121

GROUND WATER MANAGEMENT UNDER THE APPROPRIATION DOCTRINE,
Idaho Univ., Moscow. Water Resources Research Inst.
E. Bruhl, and D. R. Ralston.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 11-23. 4 fig, 11 ref.

Descriptors: *Water demand, *Administrative regulations, *Groundwater management, *Regional planning, *Appropriation, *Groundwater recession, *Water rights, Groundwater potential, Political aspects, Groundwater.

A review of the ground water management activities in the states of Washington, Idaho, Oregon and Montana demonstrates that appropriation doctrine states share common management problems. These problems fall into three categories: water level declines, water rights conflicts, and the management actions themselves. A pattern of management history is evident in states which manage ground water under the prior appropriation doctrine. The Pacific Northwest states illustrate the first three stages in this pattern. Stage one is the period of initial resource development. Water resources are managed through a system of water rights. This consists of processing water rights and resolving individual water rights conflicts. As a second stage, localized areas of persistent water level declines are identified. States attempt to solve these problems by adjusting the system of water rights through 'critical management area' designations. A third stage of development is characterized by continued water level declines on a regional scale. The scope of these problems prevents the effective management of ground water using the traditional system of water rights. Large-scale adjudications are initiated and 'critical area' designations merge and overlap. These three stages of development illustrate the management alternatives which are politically feasible in the Pacific Northwest states. The 'controlled use' management activities in Arizona represent the fourth stage in ground water development, and a departure from the appropriation doctrine. The objective of Arizona's program is to manage the entire water system of their state through centralized programs of mandatory conservation. (See also W88-11121) (Author's abstract)
W88-11122

AQUIFER PROTECTION--ONE WASHINGTON CITY'S EXPERIENCE,
CH2M/Hill, Bellevue, WA.
For primary bibliographic entry see Field 5G.
W88-11123

UNIQUE MANAGEMENT STRATEGIES FOR WASHINGTON GROUND WATER,
Washington State Dept. of Ecology, Spokane.
T. M. Olson, and D. C. Peeler.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 47-64. 9 fig.

Descriptors: *Water law, *Groundwater management, *Washington, *Management planning, *Regional planning, *Regulations, Local governments, Project planning, State jurisdiction, Groundwater potential, Financing.

In response to the growing concern about Washington State's ground water resources, the 1985 legislature passed landmark legislation designed to assist state and local governments in effectively managing the public's ground water. Substitute House Bill 232 directed the Department of Ecology to establish a process for the identification and designation of ground water management areas and for the development of comprehensive ground water management programs. In response to this legislative mandate, the department adopted a regulation under Chapter 173-100 WAC of the state administrative code. The title of this program is 'Ground Water Management Areas and Programs'. There are several advantages to local agencies and user groups in using the process described in this program. The process is designed so that a ground water management program can be initiated and developed on the local level while at the same time be supported by state legislation and regulations. Development of these ground water management programs is intended to be a team planning effort utilizing resources from interested user groups and various local and state agencies. Chapter 173-100 WAC establishes a well defined process which allows for issues, concerns and opportunities from all interested groups and agencies to be incorporated into the planning process in an effective and efficient manner. It is this type of coordination which should facilitate a wider acceptance of the program and also provide a broader authority to implement and enforce the program. In addition, passage of the Clean Water Bill (ESSB 4519) by the 1986 Legislature will allow Ecology to contribute up to 50% in matching funds for the development of ground water management programs which follow this process. (See also W88-11121) (Author's abstract)
W88-11124

DELINEATION OF SEPARATE FLOW REGIMES IN THE EDWARDS AQUIFER: A MEANS OF SUSTAINING THE SAN MARCOS SPRINGS DISCHARGE,
Southwest Texas State Univ., San Marcos.
A. E. Ogden, and R. A. Quick.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 14-32, 13 fig, 15 ref.

Descriptors: *Edwards Aquifer, *Texas, *Groundwater movement, *Flow pattern, *Springs, Flow discharge, Artificial recharge, Potentiometric map, Limestone, Environmental tracers, Chemical composition, Dissolved oxygen, Tritium, Water temperature, San Marcos Springs, Aquifers.

A recent model has predicted the cessation of flow at the San Marcos Springs to occur as early as the year 2020 due to Edwards Aquifer groundwater mining. This model did not consider separate flow systems to the various spring orifices. Two recent tracer tests have verified differing flow patterns to the springs. A year long hydrochemical analysis of six spring orifices proves that two chemically different spring groups exist. The southern group displays higher temperature, tritium, and dissolved oxygen concentrations when compared to the northern group. Also, changes in discharge have a more profound effect on the northern orifices. A detailed potentiometric surface map was constructed during low spring flow conditions 70 cfs (2.0 cms). The highly fractured and faulty Edwards Limestone produced a very complex potentiometric surface configuration. The faults associated with the Balcones Fault Zone can act as either groundwater barriers or avenues of enhanced groundwater flow. Pressure head distributions demonstrate the existence of two separate flow regimes: one of 'older' water from the San Antonio region, and the other of 'younger' water moving to the springs from the Blanco River. The potentiometric surface map also demonstrates that the Blanco River is losing water to the Edwards Aquifer through the highly fractured rock that composes the river bottom and directly recharges the San Marcos Springs. By devising ways of artificial recharge, by either drilling holes in the river bottom, diverting river water to bedrock sinkholes along the river banks, or by constructing a dam, up to 80,000 acre-ft/year (98,700,000 cu m/year) of enhanced recharge water could be contributed to the aquifer to maintain the flow of the San Marcos Springs. (See also W88-11182) (Author's abstract)
W88-11184

NATIONAL FEASIBILITY OF ARTIFICIAL RECHARGE FOR IRRIGATED LANDS,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
P. A. Hajali.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 228-250, 9 fig, 11 tab, 2 ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Aquifers, *Groundwater management, *Water supply development, *Irrigation water, Physicochemical properties, Available water, Porosity, Transmissivity, Water demand.

Artificial recharge projects have substantially increased water supplies and prevented environmental damage from declining water levels in many parts of the country. Due to this attention, the U.S. Soil Conservation Service commissioned the Environmental and Ground Water Institute to identify the potential use of artificial recharge for irrigated lands by water resources aggregated subareas (ASA's). The results for the present and future showed that approximately 90% of the 6.5 million acres of irrigated land fall into highly favorable areas for artificial recharge when the need is given equal or more weight than the physical characteristics. However, for the case where the need is given less importance, about 70% of the total irrigated lands fall under highly favorable areas for artificial recharge. Four key points are noted: (1) Based on need and physical aquifer characteristics, artificial recharge is feasible in at least 70% of the irrigated lands in the U.S. (2) Solving present water shortages for irrigation using artificial recharge methods would also solve most of the future water availability problems. (3) The results are a large scale guide to where artificial recharge activities are most needed/feasible requiring a minimum time and resource expenditure. (4) Site specific planning for installation of future artificial recharge projects would need to consider source water, legal/institutional aspects and benefit/cost analyses. (See also W88-11182) (Sand-PTT)
W88-11199

SITE SELECTION CRITERIA FOR ARTIFICIAL RECHARGE PROJECTS,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
M. P. O'Hare.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 251-265. 3 tab, 17 ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Groundwater management, *Water supply development, *Site selection, Physicochemical properties, Legal aspects, Economic aspects, Cost-benefit analysis, Aquifers.

The development of artificial recharge as a water management tool requires that site selection criteria be utilized. The success of artificial recharge projects depends on the effectiveness of the design to recharge the aquifer. With any method, be it surface spreading or injection wells, this design effectiveness is a function of the environmental setting of the aquifer, including its physical characteristics. The significant factors necessary to the development of site selection criteria have been identified through an extensive literature search and telephone survey. The physical/chemical characteristics include transmission and storage characteristics of the aquifer to be recharged; transmission characteristics of the overlying and underlying beds; thickness of the overlying beds; quantity and quality of water available for recharge, potential reactions between source water, native water and aquifer materials; topographic characteristics; and land use. Some important but often neglected factors are legal and institutional constraints, and benefit/cost analyses. The consideration of artificial recharge as a groundwater management option may arise from the development of various degrees of need. The importance of each site selection factor will vary with the level of need in an area. What has been proposed is an arrangement of consecutive actions which examine each of the physical/chemical selection criteria according to its significance for the artificial recharge project in a particular area and for a particular need. These steps include the identification of the needs of the area and the factors pertinent to artificial recharge as one management option for that area. (See also W88-11182) (Author's abstract)
W88-11200

ARTIFICIAL RECHARGE AS A MANAGEMENT TOOL FOR HYDROLOGICALLY ISOLATED AQUIFERS,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.
M. J. Dvoracek.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 266-278, 2 fig, 12 ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Groundwater management, *Water supply development, Economic aspects, Aquifers, Legal aspects, Value, Water yield.

Areas highly dependent upon groundwater as their primary source of water and experiencing significant water level declines must consider artificial groundwater recharge as a tool in water resources management. This is especially true if the aquifer is hydrologically isolated or experiencing natural recharge at a rate equivalent to a fraction of the annual yield from the aquifer. Many methods of artificial recharge have been utilized; however, total success with any method has not been achieved. Water, especially quality of water for recharge, has been a major problem in all attempts; however, other problems such as sedimentation of the aquifer, pollution and economic feasibility have received their share of attention. Successful artificial recharge can extend the life of all aquifers; however, many questions and concerns have limited extensive practice of this activity. Long range planning, research, and development in artificial recharge and its technology has been de-emphasized by public agencies and legal implications are becoming more of an issue today. Economically, artificial recharge adds an additional cost to water resource which must be paid. The question is by whom and how; part of the water management scenario of artificial groundwater recharge. (See also W88-11182) (Author's abstract)
W88-11201

MULTI-PURPOSE APPROACH TO GROUND WATER MANAGEMENT,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
D. M. Fairchild.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 279-301, 11 fig, 2 tab, 23 ref.

Descriptors: *Groundwater barriers, *Saline water barriers, *Groundwater recharge, *Artificial recharge, *Groundwater management, *Water supply development, *Saline water intrusion, Injection wells, Stormwater, Wastewater disposal, Municipal water, Aquifers, Urbanization, Water storage.

Salt water intrusion is a problem of varying severity and areal extent in many areas of the conterminous U.S. These man-made problems have been caused by overpumping, destruction of natural barriers, and a reduction of groundwater recharge through urbanization. Because the causes and geophysical characteristics of each problem area are diverse, a variety of control measures have been implemented. Management options include drilling deeper wells, relocating wells, reducing the quantity pumped through conservation, and scheduling of withdrawals. Physical control methods consist of building an extraction barrier, or freshwater ridge. Injection of stormwater or wastewater has been the most popular method of control. Local governments have been weighing advantages and disadvantages of using these control measures in California, Texas, Florida, and Georgia for many years. As population and groundwater use continues to increase, so will salt water intrusion problems. As open land becomes scarce, injection of wastewater and water storage will become more desirable. The injection method of artificial recharge is not only a method of controlling salt water intrusion, it can be used conjunctively to increase the fresh water supply and/or eliminate wastewater. An analysis was made of areas in the U.S. likely to experience an increase or continuation of salt water intrusion problems. A separate analysis was made of areas having suitable characteristics for artificial recharge. The overlapping results indicate that artificial recharge has widespread applicability to solving a variety of groundwater problems, particularly for increasing municipal water supplies in coastal areas. (See also W88-11182) (Author's abstract)
W88-11202

EFFECTS OF DEPLETION OF THE OGALLALA AQUIFER AND ACCOMPANYING IMPACT ON ECONOMIC AND AGRICULTURAL PRODUCTION IN THE SOUTHERN HIGH PLAINS REGION OF THE UNITED STATES,
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 6G.
W88-11211

PHOTOVOLTAIC WATER PUMPING FOR BOLIVIA,
Sandia National Labs., Albuquerque, NM.
H. N. Post, and P. Garvison.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-008967. Price codes: A02 in paper copy, A01 in microfiche. Sandia Laboratory Report No. SAND--87-1113C, (1986). 12 p, 6 fig, 1 tab, 2 ref.

Descriptors: *Pumps, *Photovoltaic pumps, *Water pumps, *Bolivia, Hydraulic machinery, Developing countries, Design standards, Installation, Pilot plants, Pumps, Economic aspects, Potable water, Education.

The design, installation and performance of photovoltaically-powered water pumping systems that provide potable water to residents of three villages in the Altiplano region of Bolivia are described. The installation of these systems during August 1986 was the culmination of a cooperative effort between the World Bank, U.S. Department of Energy and the Bolivian government. This project was configured to demonstrate, through pilot systems, the many potential benefits of using photovoltaic water pumping in developing countries. Several important objectives of the project were achieved. First, three high quality PV water pumping systems, each with high visibility from The World Bank and the Bolivian government, were installed and are operating properly. Second, extensive education and training sessions on PV water pumping were provided to personnel from several Bolivian government agencies. This educational activity is critical to making potential users aware of the benefits of PV. Last, the project has provided a stimulation to PV procurement in Bolivia and the direct involvement of U.S. industry in the Bolivian market. (Lantz-PTT)
W88-11274

4C. Effects On Water Of Man's Non-Water Activities

ONCHOCERCIASIS CONTROL PROGRAMME IN WEST AFRICA: TEN YEARS MONITORING OF FISH POPULATIONS,
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
C. Leveque, C. P. Fairhurst, K. Abban, D. Paugy, and M. S. Curtis.
Chemosphere CMSHAF, Vol. 17, No. 2, p 421-440, 1988. 10 fig, 53 ref.

Descriptors: *Onchocerciasis, *Public health, *Population exposure, *Insecticides, *Pesticides, *Fish populations, *Water pollution effects, Water pollution control, Diseases, Human diseases, West Africa.

Commencing in 1975, under the auspices of the World Health Organization (WHO), weekly applications of insecticides have been employed to control the blackfly that transmits human river blindness in West Africa. The results provided in this paper do not show, as a whole, any clear impact of OCP-applied pesticides on fish populations. The total catch, the number of species caught in each sample and coefficient of condition appeared to fluctuate around a mean value, and no long-term drop was observed over the period investigated. The seasonal pattern is generally clear. In some cases, longer term decline does occur, generally being followed by a rise correlating with changing hydrological conditions. (Author's abstract)
W88-10141

DEPENDENCE OF THE CHEMICAL COMPOSITION OF THE WATER IN THE RIVER RUDAWA (SOUTHERN POLAND) ON ITS FLOW,
Polish Academy of Sciences, Krakow. Inst. of Botany.
For primary bibliographic entry see Field 5B.
W88-10171

EFFECT OF DEFORESTATION ON THE WATER CYCLE IN THE AMAZON BASIN: AN ATTEMPT REFORMULATE THE PROBLEM,
Weizmann Inst. of Science, Rehovoth (Israel).
J. R. Gat, E. Matsui, and E. Salati.
Acta Amazonica AMAZA, Vol. 15, No. 3-4, p 307-310, September-December 1985. 6 ref.

Descriptors: *Rainfall, *Meteorology, *Evaporation, *Clouds, *Cloud cover, *Atmospheric water, *Amazon Basin, Forests, Research priorities, Atmospheric stability, Deforestation.

If widespread deforestation in the Amazon results in reduced evaporative water flux, then either a decrease in evaporation is compensated locally by reduced rainfall, or else the changed moisture balance expresses itself downwind in the as yet undisturbed forest. It is suggested that the appearance of clouds and the occurrence of rainout is governed primarily by the interplay of local meteorologic and physical geography parameters with the atmospheric stability structures except for a few well-defined periods when rain is dominated by large scale atmospheric instability. This means that the study of these phenomena (local heat balances, studies on cloud formation mechanism, vertical atmospheric stability, etc) must be made on the scale of the cloud size, a few tens of kilometers at most. (Author's abstract)
W88-10191

INFLUENCE OF MICROHABITAT ON AVAILABILITY OF DRIFTING INVERTEBRATE PREY TO A NET-SPINNING CADDISFLY,
Georgia Univ., Athens. Dept. of Entomology.
F. L. Smith-Cuffney, and J. B. Wallace.
Freshwater Biology FWBLAB, Vol. 17, No. 1, p 91-98, February 1987. 3 fig, 4 tab, 34 ref. NSF Grant BSR 8012093.

Descriptors: *Aquatic habitats, *Streams, *Microenvironment, *Caddisflies, *Invertebrates, *Streamflow, *Clear-cutting, River basins, Sediment load, Population density, Foods, Nets, Aquatic insects, Riffles, Stream drift, Secondary productivity.

Invertebrate drift was sampled at both a rockface and a deep pebble riffle site in streams draining both a clearcut and a forested catchment. A sampler was designed to separate the bottom 2 cm of flow, encompassing the effective range of caddisfly (Hydropsychidae: Trichoptera) catchnets, from upper flow. No significant difference in drift density (numbers per cubic meter) was seen between sites within each stream. However, numbers per square centimeter intake area per day at the rockface sites were four times higher in the clearcut and ten times higher in the forested stream than at the pebble-riffle site. Rockface habitat which had highest drift availability was also the site of maximum secondary production of the predaceous collector-filterer Parapsyche cardis in both streams studied. Increased sediment load in the clearcut stream may influence the efficiency of utilization of invertebrate drift by collector-filterers. (Author's abstract)
W88-10213

FOREST WATER USAGE AND INTERACTIONS WITH NUTRITION OF PINUS RADIATA,
Forestry Commission of New South Wales, Beecroft (Australia).
For primary bibliographic entry see Field 2I.
W88-10282

EUTROPHICATION OF LAKE LESTIJARVI AS A CONSEQUENCE OF FOREST BOG DITCHING,
Jyvaeskylae Univ. (Finland). Inst. for Environment Research.
K. Granberg.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 57-61, 1987. 3 fig, 18 ref.

Descriptors: *Finland, *Lake Lestijarvi, *Lakes, *Eutrophication, *Land reclamation, *Forest management, Dam failure, Phytoplankton, Peat, Nutrients, Fuel, Oligotrophic lakes, Bogs, Forest bog ditching, Runoff, Rainfall.

Lake Lestijarvi (area 64 sq km, volume 170 million cu m, outflow 3 cu m/s) was oligotrophic for a long time. In the summer of 1981, a massive phytoplankton bloom occurred in the lake. It has been claimed that this was due to the effluents from a bog being prepared for the digging of fuel peat after the breaking of the dam of the effluent pond in May of 1981. The comparison of the phosphorus balance results with the loading capacity of the lake showed that the lake can become eutrophic. Also, the results from an 18 cm long sediment core showed that a slow eutrophication process had started earlier, and that the most probable cause was the ditching of forests and bogs in the drainage area of the lake. The ditching began at the end of the 1950s. The lake was still oligotrophic in 1963, and the first signs of eutrophication appeared at the end of the 1960s. The phytoplankton bloom in 1981 was a consequence of the interaction on both the increased nutrient runoff of the heavy rainfall and the breaking of the effluent pond dam in the bog. (Author's abstract)
W88-10292

WINTER AND SUMMER LOW FLOWS IN FINLAND,
National Board of Waters, Helsinki (Finland). Hydrological Office.
For primary bibliographic entry see Field 2E.
W88-10303

BIOLOGICAL EFFECTS OF DREDGING IN AN OFFSHORE BORROW AREA,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
R. O. Johnson, and W. G. Nelson.
Florida Scientist FLSCA, Vol. 48, No. 3, p 166-188, Summer 1985. 7 fig, 6 tab, 11 ref. Army Corps of Engineers, Jacksonville Dist. Contract DACW17-80-C-0058.

Descriptors: *Dredging, *Borrow pits, *Benthic fauna, *Coastal waters, *Population density, Trenches, Marine sediments, Species diversity, Species composition, Ecosystems, Beach erosion, Florida.

Changes in benthic fauna were monitored following excavation of an offshore borrow area in the vicinity of Fort Pierce Inlet, Florida. Sampling stations were established along 2 transects located in the borrow area, 1 control transect north of the borrow area, and 1 control transect south of the borrow area. Results suggest that relatively larger reductions in abundance, but not number of species, of the benthic fauna occurred in the borrow area following dredging as compared with the controls. Therefore the decrease observed appears greater than can be accounted for on the basis of seasonal changes alone. Both parameters returned to pre-dredging levels in from 9-12 months. Species composition, however, was altered in the borrow area and had not returned to the pre-dredging composition after 12 months. It is probable that this species shift is not detrimental in that it resembles the species composition at other undisturbed locations in this region. (Author's abstract)
W88-10444

CARBON DIOXIDE DYNAMICS IN MIRES RECLAIMED FOR FORESTRY IN EASTERN FINLAND,
Joensuu Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-10509

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): III. IMPACT OF MAN ON THE MATTER INPUT AND SEDIMENTATION IN THE PAST,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W88-10592

POLLUTION OF SURFACE WATERS IN AN AGRICULTURAL WATERSHED ON THE EXAMPLE OF THE SUCHA RIVER.
Institute of Meteorology and Water Management, Warsaw (Poland).
For primary bibliographic entry see Field 5B.
W88-10609

STUDY OF SOME PHYSIOCHEMICAL PROPERTIES OF NILWALA RIVER WATERS IN SOUTHERN SRI LANKA WITH SPECIAL REFERENCE TO EFFLUENTS RESULTING FROM ANTHROPOGENIC ACTIVITIES,
Ruhuna Univ., Matara (Sri Lanka). Dept. of Botany.
M. P. de Silva, R. Karunatileka, and W. Thiemann.
Journal of Environmental Science and Health JESEDU, Vol. 23, No. 4, p 381-398, May 1988. 14 fig, 4 tab, 4 ref.

Descriptors: *Sri Lanka, *Water quality, *Rivers, Industrial wastes, *Farm wastes, *Water pollution effects, *Physiocochemical properties, *Sri Lanka, Hydrogen ion concentration, Water properties, Chemical properties, Chloride, Ammonia, Nitrite, Dissolved oxygen, Seasonal variations, Catchments, Monitoring, Wastewater treatment, Tropical regions, Agriculture.

The water quality of Nilwala Ganga river in Southern Sri Lanka is described in terms of variations of the following parameters with seasons and length of river: acidity, chloride, ammonia, nitrite, biological oxygen demand, dissolved oxygen, and conductivity. The influence of rainy season and agricultural activity in the catchment area of Nilwala is clearly demonstrated. The need for systematic monitoring and wastewater treatment of waters of tropical rivers is evident, in particular where impacts from industrial-agricultural projects are to be expected. (Author's abstract)
W88-10641

EFFECT OF WHOLE-TREE HARVEST ON EPILITHIC BACTERIAL POPULATIONS IN HEADWATER STREAMS,
Michigan State Univ., East Lansing. Dept. of Zoology.
S. K. Haack, T. Burton, and K. Ulrich.
Microbial Ecology MCBEBU, Vol. 16, No. 3, p 165-181, 1988. 6 fig, 4 tab, 45 ref. NSF Grant BSR 831-5001.

Descriptors: *Acid rain effects, *Clear-cutting, *Forest management, *Stream biota, *Bacteria, Trees, Seasonal variation, Biomass, Hydrogen ion concentration, Fluorescence, Microscopy, Electron microscopy, Nitrates, Artificial watercourses, Forest watersheds, Logging.

Bacteria attached to rock and glass surfaces were studied in streams draining a whole-tree harvested watershed and a nonharvested watershed in the Hubbard Brook Experimental Forest, New Hampshire. Seasonal trends in numbers of cells/sq cm, mean cell volume, cell size-frequency distribution and bacterial biomass were determined using 4'6-diamidino-2-phenylindole epifluorescent microscopy and scanning electron microscopy. The response of these parameters to decreased pH and increased nitrate concentration in the whole-tree harvested stream was assessed via controlled manipulation of stream water chemistry in artificial channels placed in the nonharvested watershed. Bacterial distribution varied significantly between the two streams and seasonally within each stream in apparent response to differential availability of dissolved organic carbon from algae and autumn-shed leaves. Decreased pH similar to that in the whole-tree harvested stream had a significant effect on cell numbers, mean cell volume and biomass in the nonharvested watershed. Decreased pH accounted for some aspects of the altered bacterial distributions observed in the whole-tree harvested stream. Nitrate at concentrations similar to those in the whole-tree harvested stream had no effect on bacterial distribution in the nonharvested watershed which suggests that headwater stream epilithic bacteria were carbon limited. (Author's abstract)
W88-10771

EFFECT OF MASS CHEMOTHERAPY AND PIPED WATER ON NUMBERS OF SCHISTOSOMA HAEMATOBIUM AND PREVALENCE IN BULINUS GLOBOSUS IN KWALE, KENYA,
Kagoshima Univ. (Japan). Dept. of Medical Zoology.
For primary bibliographic entry see Field 6B.
W88-10840

EPILITHIC ALGAL NITROGEN FIXATION, STANDING CROPS AND PRODUCTIVITY IN FIVE RIVERS FLOWING THROUGH THE OILSANDS REGION OF ALBERTA/CANADA,
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W88-10889

URBAN STORMWATER FLOW RATE AND QUALITY PREDICTION: THE FLUPOL MODEL (PREVISION DES DEBITS ET DES FLUX POLLUTANTS TRANSITES PAR LES RESEAUX D'EGOUTS PAR TEMPS DE PLUIE: LE MODELE FLUPOL),
Compagnie Generale d'Automatisme, Paris (France).
G. Bujon.
La Houille Blanche, No. 1, p 11-23, 1988. 3 fig, 10 ref. English summary.

Descriptors: *Model studies, *Storm runoff, *Urban runoff, *Storm sewers, *Water pollution sources, FLUPOL model, Mathematical models, Simulation analysis, Paris, France, Urban hydrology, Storm water.

Urban stormwater runoff has gradually become an important source of stream pollution. The use of stormwater simulation and river water quality models helps to appreciate the impact of urban stormwater runoff on the receiving streams. FLUPOL was developed to simulate the quantity and quality response of urban sewer networks with the smallest possible number of data. The model presentation is followed by a validation from measurements carried out in a large size storm sewer of a large urban area located south of Paris. (Author's abstract)
W88-10904

EFFECTS OF CONSERVATION TILLAGE ON GROUNDWATER QUALITY: NITRATES AND PESTICIDES.
Lewis Publishers, Chelsea, Michigan. 1987. 292 p. Edited by Terry J. Logan, James. M. Davidson, James L. Baker and Michael R. Overcash.

Descriptors: *Groundwater pollution, *Cultivation, *Water quality, *Agricultural hydrology, *Nitrates, *Pesticides, Groundwater management, Organic pesticides, Organic compounds, Path of pollutants, Great Lakes, Soil physical properties, Soil chemistry, Soil contamination.

The potential contamination of groundwater, and to a less extent surface water, by nitrate and pesticides as a result of widespread shifts form inversion tillage to conservation tillage is discussed. Concern for groundwater contamination by agricultural and industrial chemicals commands national attention today. Nitrate and pesticides receive considerable attention because of the large quantities used by farmers and because of the high mobilities of nitrate and some of the pesticides in soil. The question posed is not whether these compounds migrate to groundwater as a result of agricultural practices, or the extent of groundwater contamination. Rather, the authors were asked to consider whether extensive shifts from inversion tillage to conservation tillage would increase the potential for groundwater contamination by nitrate and pesticides. The first three chapters provide background on the extent of conservation tillage practices currently used in the U.S., and pesticide and nitrogen fertilizer use with conservation tillage. These are followed by a review chapter on non-point-source pollution in the Great Lakes, with particular emphasis on nitrogen and pesticides. A series of chapters are then presented on effects of conservation tillage on physical, chemical, and biological processes in soil and on surface and groundwater hydrology. The next lead and discussion chapters concern nitrogen and pesticide fate and transformation in soil, and the final chapter is on interactions of conservation tillage and agricultural waste management. (See W88-11068 thru W88-11083) (Friedmann-PTT)
W88-11067

HYDROLOGIC SOIL PARAMETERS AFFECTED BY TILLAGE,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
C. A. Onstad, and W. B. Voorhees.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 95-112, 6 fig, 3 tab, 40 ref.

Descriptors: *Tillage, *Soil conservation, *Erosion control, *Agricultural hydrology, *Soil water, *Soil physical properties, *Rainfall, Soil management, Soil engineering, Soil environment, Degradation, Sediment erosion, Rainfall-runoff relationships.

Conservation tillage-induced changes in soil physical conditions affecting hydrologic response were examined. Conservation tillage leaves considerable residue on the soil surface, leaves the soil surface rough or ridged, and mixes the residue and soil to varying degrees within the management zone. After tillage, the presence of residue together with soil physical parameters and weather influence the degradation rate of the conditions established. Often, studies are conducted relating runoff rates and quantities of rainfall, both expressed precisely, without regard for quantitative expression of the soil characteristics. In order for trends to be extrapolated, it is not sufficient to use qualitative terms such as 'moldboard plowing' or 'no till' to express soil conditions during the event. Instead, the soil needs to be quantified in terms of stability, total pore space, and pore size distribution. Tilled soil physical properties are dynamic. They are affected by type of tillage, tillage sequence, wheel traffic, and natural degradation factors. Most important, natural factors include rainfall kinetic energy, soil wetting and drying cycles, and soil freezing and thawing cycles. The major affected soil physical properties, including effects of residue management, soil surface characteristics, and the soil management zone as influenced by tillage and natural degradation are described. These are related to tillage characteristics and natural degradation. (See also W88-11067) (Friedmann-PTT)
W88-11072

HYDROLOGIC EFFECTS OF CONSERVATION TILLAGE AND THEIR IMPORTANCE RELATIVE TO WATER QUALITY,
Iowa State Univ., Ames.
J. L. Baker.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 113-124, 5 tab, 33 ref.

Descriptors: *Path of pollutants, *Agricultural runoff, *Agricultural hydrology, *Nitrates, *Pesticides, *Water quality, Infiltration, Runoff, Aquifers, Aquifer recharge, Adsorption, Leaching, Soil profiles, Surface runoff, Surface water, Groundwater pollution.

Some aspects of hydrology are reviewed that should be clearly understood by anyone wishing to make judgments on the effects of conservation tillage on water quality. Timing and route of infiltration, as well as volume of infiltrating water are very important relative to chemical losses in surface runoff and subsurface drainage, which may recharge aquifers or be intercepted by shallow drain tubes. The volume of drainage water is important in determining losses, but for surface-applied chemicals that are not strongly adsorbed, initial infiltration before runoff begins can be an important factor in decreasing concentrations and

losses in surface runoff. The route that leaching water takes through the soil profile (e.g., through macropores) relative to the location of a chemical of concern can strongly influence leaching losses. It is not yet conclusive whether conservation tillage decreases surface runoff and/or increases subsurface drainage because of the large number of factors affecting infiltration. (See also W88-11067) (Friedmann-PTT)
W88-11073

SOIL CHEMICAL AND BIOLOGICAL PROPERTIES AS AFFECTED BY CONSERVATION TILLAGE: ENVIRONMENTAL IMPLICATIONS,
Ohio State Univ., Wooster. Agricultural Technical Inst.
W. A. Dick, and T. C. Daniel.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 125-147, 4 fig, 7 tab, 64 ref.

Descriptors: *Tillage, *Agricultural runoff, *Water pollution sources, *Erosion control, *Agricultural hydrology, *Soil properties, Soil-water-plant relationships, Root zone, Vadose zone, Soil environment, Soil organic matter, Nutrients, Fertilizers, Phosphorus.

Changes in distribution of plant nutrients in soil profiles brought about by the application of conservation tillage practices are described, with a brief overview of the effect of conservation tillage on biological properties (e.g. earthworm activity, plant diseases, and insects). The changes described provide a context in which water quality, as affected by tillage, is discussed. When compared to conventional tillage, the surface soil layer of conservation tillage fields, especially no-tillage, becomes enriched in hydrogen ions, plant nutrients, and biological activity. In the lower portion of the rooting zone, from approximately 5 to 10 cm depth, the opposite trend often occurs and the no-tillage soil has lower concentrations of the chemical and biological parameters. Tillage operations, in which the soil is inverted and mixed, tends to counteract changes in chemical and biological parameters. However, with conservation tillage and most notably no-tillage, the growing of annual crops and additions of fertilizer produce changes in the soil profile that are noticeable in only a few years. In some soil types, conservation tillage requires increased fertilzer use, which may lead to increased fertilizer concentrations in the surface runoff. (See also W88-11067) (Friedmann-PTT)
W88-11074

EFFECT OF CONSERVATION TILLAGE ON BIOLOGICAL AND CHEMICAL SOIL CONDITIONS: REGIONAL AND TEMPORAL VARIABILITY,
Kentucky Univ., Lexington.
M. S. Smith, and R. L. Blevins.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 149-166, 6 fig, 5 tab, 31 ref.

Descriptors: *Tillage, *Erosion control, *Water pollution sources, *Soil properties, Soil-water-plant relationships, Soil profiles, Stratification, Root zone, Vadose zone, Soil environment, Soil types, Climate, Mulches, Air-earth interface, Soil temperature, Microbiological studies, Nutrients, Pesticides, Soil organic matter.

Data are presented illustrating that the effects of conservation tillage vary with: time of year, time (years) since initiation of the tillage system, climate, soil type and previous management. The most widely applicable generalization is that conservation tillage results in a stratification of the soil, with a relative accumulation of nutrients, acidity, organic matter and microbes near the surface. The magnitude of this effect, and the nature of other biological and chemical effects, will vary. It is not expected that reduced evaporation by surface residues will have the same effect on microbial activity in a poorly-drained clay and in a well-drained sand. Reduced temperatures under a no-till mulch can decrease microbial respiration in Minnesota but increase it in Nigeria. Because tillage per se is not a primary, direct determinant of biological activity, it seems that predicting tillage system effects on biological activity must be an indirect, two-step process. First, it must be understood how tillage systems influence the chemical and physical environment of soil organisms, particularly temperature, moisture and substrate availability. Second, it must be understood, in a quantitative and dynamic way, how microbes and the reactions they catalyze are affected by these environmental changes. (See also W88-11067) (Friedmann-PTT)
W88-11075

EFFECTS OF CONSERVATION TILLAGE PRACTICES ON PESTICIDE VOLATILIZATION AND DEGRADATION,
Agricultural Research Service, Beltsville, MD.
D. E. Glotfelty.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 169-177, 9 ref.

Descriptors: *Tillage, *Erosion control, *Path of pollutants, *Pesticides, *Soil physical properties, Microclimate, Soil temperature, Soil water, Soil organic matter, Air-earth interface, Volatility, Chemical properties, Soil chemistry.

The effects on pesticide dissipation of conventional seed bed preparation through plowing and discing, and no-till, in which the seed is introduced into unplowed soil in narrow openings sufficiently deep to cover the seed and provide soil contact are compared. Compared to conventional till, no-till changes soil properties and soil surface microclimate in ways that may profoundly affect pesticide dissipation by volatilization, degradation, and plant uptake because these dissipation processes are influenced by soil temperature, soil-water content, soil organic matter, soil water and air movement, and soil chemical properties such as pH. One of the most significant changes that may accompany conversion to conservation tillage is in how the pesticide is managed. If a pesticide that is normally incorporated into the soil in a conventional tillage system is instead applied to the surface without incorporation in a no-till system, it is likely that a significant change in the rate and mechanisms of dissipation will occur. A second significant difference between conventional and no-till systems is the presence of the surface mulch that intercepts the pesticide spray and alters the microclimate at the soil surface. Other important differences include soil temperature, altered moisture content and distribution within the soil, and altered organic matter content and distribution within the soil. (See also W88-11067) (Friedmann-PTT)
W88-11076

EFFECT OF CONSERVATION TILLAGE ON PESTICIDE DISSIPATION,
Agricultural Research Service, Beltsville, MD.
C. S. Helling.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 179-187, 2 fig, 2 tab, 21 ref.

Descriptors: *Tillage, *Erosion control, *Fate of pollutants, *Soil chemistry, *Soil physical properties, *Pesticides, Soil temperature, Soil moisture retention, Soil water, Degradation, Hydrogen ion concentration.

Research examples of how tillage has affected soil properties and pesticide persistence are presented. The research shows that pesticide dissipation changes that are caused by conservation tillage practices are of uncertain magnitude. Among reasons for this uncertainty are the wide range of tillage practices which, in turn, lead to differing impacts on soil physical and chemical properties. The extreme situation, no-till farming, can lead to higher organic matter content, cooler soil temperature, higher moisture content, lower pH, and greater microbial activity; these effects are most pronounced nearest the surface. Pesticide degradation is probably somewhat faster in no-till than in conventional tillage. (See also W88-11067) (Friedmann-PTT)
W88-11077

PROCESSES INFLUENCING PESTICIDE LOSS WITH WATER UNDER CONSERVATION TILLAGE,
Cornell Univ., Ithaca, NY.
R. J. Wagenet.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 189-204, 2 fig, 1 tab, 34 ref.

Descriptors: *Agricultural runoff, *Erosion control, *Tillage, *Pesticides, *Surface runoff, *Path of pollutants, *Leaching, Model studies, Soil organic matter, Fate of pollutants.

The basic physical, chemical, and biological processes that must be involved in pesticide fate under conservation tillage are well-documented and can provide a framework within which both knowns and unknowns regarding such fate can be organized. The literature concerning pesticide usage under conservation tillage, processes affecting pesticide fate under conservation tillage, and pesticide losses via surface runoff and leaching are reviewed. A number of models are considered including those of processes affecting surface runoff and leaching and resultant pesticide loading of surface waters. The influence of organic debris at the soil surface upon pesticide partitioning between aqueous and sorbed phases warrants further study; improved models useful in predicting pesticide loss by surface runoff and leaching are needed. (See also W88-11067) (Friedmann-PTT)
W88-11078

EFFECTS OF CONSERVATION TILLAGE ON PESTICIDE LOSS WITH WATER,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. D. Wauchope.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 205-215, 1 fig, 42 ref.

Descriptors: *Agricultural runoff, *Tillage, *Erosion control, *Path of pollutants, *Pesticides, *Groundwater pollution, Surface water, Herbicides, Surface runoff, Bed load, Sediment transport.

The question of whether the adoption of conservation tillage practices lead to increase nonpoint inputs of pesticides, especially herbicides, to surface and groundwater is addressed. Adoption of conservation tillage seems to increase use of herbicides, though no such generalization can be made for other pesticides. Pesticide runoff losses are proportional to use; sediment and water, and their associated pesticides, can be treated independently. Many tillage operations and pesticide applications occur at the same time, at or near planting. Tillage effects on runoff volume and sediment load thus will occur during that period when applications are fresh and have the highest potential for leaching or runoff. (See also W88-11067) (Friedmann-PTT)
W88-11079

EFFECT OF CONSERVATION TILLAGE ON FATE AND TRANSPORT OF NITROGEN,
North Carolina State Univ., Raleigh.
J. W. Gilliam, and G. D. Hoyt.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 217-240, 5 tab, 69 ref.

Descriptors: *Agricultural runoff, *Leaching, *Erosion control, *Nitrogen, *Path of pollutants, Fate of pollutants, Volatility, Denitrification, Sediments, Fertilizers, Soil water, Soil moisture retention.

Information about the fate of nitrogen (N) in some processes was used to estimate the quantities of N that may be involved in those processes that have

been less studied. The fate of N in conservation tillage or no-till is compared to that in conventional tillage. Volatilization of N as ammonia is a much larger problem with surface-applied urea-based fertilizers in no-till than in conservation tillage. Denitrification losses also tend to be greater under no-till as compared to conventional tillage, largely because of the increased moisture in the no-till fields. There has been a large amount of work quantifying the amount of N that is either mineralized or immobilized under conservation tillage management. It is clear that conversion from conventional tillage to any from o conservation tillage will usually result in an increase in organic N present in the soil. No-till results in less total nitrogen loss by surface runoff compared to conventional tillage as a result of a decrease in sediment-associated organic nitrogen. Studies of nitrogen leaching indicate that conservation tillage may increase or decrease leaching in the short term depending on soil and other factors. Under some conditions, the introduction of conservation tillage may have increased the environmental problems caused by nitrogen leaching. (See also W88-11067) (Friedmann-PTT)
W88-11080

EFFECT OF CONSERVATION TILLAGE ON PROCESSES AFFECTING NITROGEN MANAGEMENT,
Agricultural Research Service, Lincoln, NE.
J. S. Schepers.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 241-250, 2 fig, 1 tab, 18 ref.

Descriptors: *Tillage, *Erosion control, *Agricultural chemical, *Water polluton sources, *Nitrates, *Groundwater pollution, Soil physical properties, Soil chemistry, Biological properties, Percolation, Soil water, Vadose water, Root zone, Microclimate, Groundwater quality, Leaching.

Interactions between the chemical, biological and physical processes involved in tillage systems were examined in an attempt to evaluate systematically the potential effect on groundwater quality. The physical process of nitrate leaching requires sufficient soil water for percolation and availability of nitrate ions in close proximity to the moving water. Soils with little structure transmit percolating water very rapidly and readily contribute any available nitrate to the solution. Finer textured soils tend to promote better structure, especially in the root zone where organic matter is more prevalent, and reduce the percolation rate. However, fine textured soils do not always have low infiltration rates. Soil-water content fluctuations are usually greater in the root zone than in the vadose zone because of plant growth and evaporation. Therefore, climatic factors and processes within the root zone are the most likely to influence groundwater quality. While conservation tillage may alter the nitrogen (N) form over a period of months to a few years, the total amount of root zone N may not vary greatly with tillage system. Evaluating the potential for nitrate leaching and subsequent groundwater pollution under no-tillage production systems is difficult. Expanded knowledge dealing with macropore water flow and subsequent leaching of nitrate and pesticides will be required before the impact of conservation tillage systems is completely evaluated. (See also W88-11067) (Friedmann-PTT)
W88-11081

MANURE MANAGEMENT WITH CONSERVATION TILLAGE,
Cornell Univ., Ithaca, NY.
M. F. Walter, T. L. Richard, P. D. Robillard, and R. Muck.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 253-270, 5 fig, 3 tab, 14 ref.

Descriptors: *Water pollution sources, *Agricultural runoff, *Tillage *Erosion control, *Nitrogen, Manure, Farm wastes, Fertilizers, Crop yields, Surface runoff, Nutrients, Economic aspects, Groundwater pollution.

The role of manure management in a conservation tillage program is discussed, with emphasis on dairy farms. It was observed that: (1) conservation tillage and manure management are compatible; (2) effects of marurial nitrogen on crop yields are the same for both moldboard and chisel plowing; (3) losses of manurial nutrients in surface runoff are greatly reduced by a little incorporation; (4) manurial residue can significantly reduce runoff from cropland where residue has been removed; (5) management costs of utilizing manurial nutrients as perceived by the farmer can be extremely high; and (6) because manure is not generally utilized as a fertilizer source, there is a potential groundwater problem with any tillage system. (See also W88-11067) (Friedmann-PTT)
W88-11082

ASSESSMENT OF GREAT LAKES TILLAGE PRACTICES AND THEIR POTENTIAL IMPACT ON WATER QUALITY,
Ohio State Univ., Columbus.
T. J. Logan.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 271-276, 9 ref.

Descriptors: *Water pollution sources, *Agricultural runoff, *Erosion control, *Tillage, *Water quality, *Groundwater pollution, Water pollution, Surface water, Nitrates, Crop yields, Fertilizers, Corn, Surface runoff, Phosphorus, Nonpoint pollution sources.

A specific perspective of the Great Lakes region is presented, i.e., the impacts of climate, soils, crops, specific cultural practices, and weed and insect pressures on tillage practices and the effects of these variables on the potential for nitrate and pesticide contamination of surface and groundwater in this region. Conservation tillage is being promoted in the Basin for control of nonpoint sources of phosphorous to the Great Lakes and the data indicate that Basin farmers are adopting this practice at a steady rate although most are shifting to a system minimizing tillage rather than stictly no-till. Corn, soybeans, and winter wheat are the major crops of the region and, of these, only corn receives nitrogen fertilizer at rates that could contribute significantly to losses of nitrate in runoff and tile drainage or movement of groundwater. This potential for nitrate contamination of surface and groundwater with corn fertilization is a consequence of less-than-precise nitrogen fertilizer recommendations and less-than-efficient timing of fertilizer applications, regardless of the tillage system used. With the low overall use of no-till in the Basin compared to other types of conservation tillage, the impact of accelerated conservation tillage used by Basin farmers on pesticide contamination of water supplies is likely to be small with the greatest effect being seen in surface rather than groundwater. (See also W88-11067) (Friedmann-PTT)
W88-11083

ENVIRONMENTAL EFFECTS OF RADIATION EMERGENCIES,
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
L. D. Hamilton.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010450. Price codes: A02 in paper copy, A01 in microfiche. Brookhaven National Lab. Report No. BNL--39591, March 1987. 19 p, 1 fig, 6 tab, 6 ref. DOE Contract DE-AC02-76CH00016.

Descriptors: *Nuclear reactors, *Environmental effects, *Radiation, *Chernobyl, *Soviet Union, Radioactivity, Air pollution, Water pollution, Public policy.

Large radioactive releases can involve nuclear reactors, reprocessing plants, or transportation of spent fuel and high-level waste. This paper focuses on reactor accidents because more is known about the few reactor accidents; these potentially have the gravest consequences. Briefly discussed is radioactivity in air, water, soil, and the food chain to man. Some of the uptake paths are outlined and, by implication, mitigating procedures. Focus is then placed on some of the environmental aspects of the most recent disaster: Chernobyl. (Lantz-PTT)
W88-11281

4D. Watershed Protection

OVERVIEW OF CONSERVATION TILLAGE,
Purdue Univ., Lafayette, IN.
J. V. Mannering, D. L. Schertz, and B. A. Julian.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 3-17, 2 fig, 6 tab, 14 ref.

Descriptors: *Tillage, *Erosion control, *Sediment control, *Soil conservation, *Agricultural engineering, *Agricultural hydrology, Sediment erosion.

Because of the confusion on terminology, the Conservation Tillage Information Center (CTIC) defined conservation tillage, an umbrella term, as any tillage and planting system that maintains at least 30% of the soil surface covered by residue after planting to reduce soil erosion by water; or where soil erosion by wind is the primary concern, maintains at least 450 kg per acre of flat small grain residue equivalent on the surface during the critical erosion period. Types falling under this umbrella term include no-till or slot planting, ridge-till, strip-till, mulch-till, and reduced-till. Conventional tillage refers to the combined primary and secondary tillage operation normally performed in preparing a seedbed for a given crop grown in a given geographical area. Current trends and acreages in U.S. conservation tillage are reviewed, based on 1985 estimates. The most significant factor affecting soil and water loss is crop residue cover; the contrast between conservation tillage and conventional tillage is discussed as to their effects on percent residue cover. The sheet and rill erosion reduction benefit of conservation tillage varies between 50 and 90% compared to erosion under conventional tillage. Although this dramatic reduction is well documented, the corresponding effect of conservation tillage on sediment reduction is not. (See also W88-11067) (Friedmann-PTT)
W88-11068

OVERVIEW OF PEST MANAGEMENT FOR CONSERVATION TILLAGE SYSTEMS,
Iowa State Univ., Ames.
R. S. Fawcett.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 19-37, 1 fig, 67 ref.

Descriptors: *Tillage, *Soil conservation, *Agricultural engineering, *Agricultural hydrology, *Pesticides, *Weeds, *Plant pathology, Vegetation, Crop production, Herbicides, Mulches.

The implications of conservation tillage on weeds, insects, and plant pathogens and on projected changes in pesticide use are addressed. Tillage kills existing vegetation and creates and even-start situation for the crop and weeds that must begin growth from seeds or vegetative propagules. According to the existing literature, weed seedlings germinating in response to tillage are killed by a second tillage operation. This procedure is repeated several times prior to crop planting. Changes in tillage practices may favor certain weed species over others. The tillage system used may dictate herbicide application method options. For example, herbicides used in mulch tillage systems are often identical to herbicides used with conventional tillage, while incorporation of herbicides is not possible with no-till or ridge-till systems, limiting herbicide options to preemergence of postemergence. Certain insect pests have been noted to be more prevalent with conservation tillage, while others are either not directly affected by tillage or have decreased with conservation tillage. Most cases of increases of insect pests have been associated with no-till. Potentially, conservation tillage could impact many diseases, as inoculum is often carried on plant debris. Burying corp residue with

tillage has been a suggested control technique for many foliar diseases. (See also W88-11067) (Friedmann-PTT)
W88-11069

OVERVIEW OF NITROGEN MANAGEMENT FOR CONSERVATION TILLAGE SYSTEMS: AN OVERVIEW,
Minnesota Univ. Technical Coll., Waseca.
G. W. Randall, and V. A. Bandel.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 39-63, 12 tab, 26 ref.

Descriptors: *Tillage, *Water pollution control, *Soil conservation, *Agricultural engineering, *Groundwater pollution, *Nitrates, Leaching, Soil organic matter, Soil water, Volatility, Denitrification, Water pollution sources.

The management of nitrogen (N) in conservation tillage practices is reviewed. Conservation tillage leaves significant amounts of plant residues on the soil surface that can greatly affect water intake and N loss mechanisms, e.g., volatilization, leaching, and denitrification. Volatilization losses of N from surface-applied urea-containing N fertilizers can be substantial. Moreover, for a variety of reasons, the trend among producers has been to move away from anhydrous ammonia toward urea and UAN, which are often surface-applied. Paradox requires the development of better injection/incorporation techniques that allow growers to manage their N better in the future. Agronomists throughout the U.S. recognize this volatilization problem and many make recommendations to guard against these losses. In some cases, higher rates of N are recommended with conservation tillage compared to conventional tillage. This could lead to increased amounts of NO3 leached toward the groundwater if the N is not taken up by the plant, volatilized, immobilized or denitrified. The role of conservation tillage on the fate of N in a cropping system needs to be defined more clearly with further research, especially with respect to immobilization, mineralization, and water flow characteristics. (See also W88-11067) (Friedmann-PTT)
W88-11070

HYDROLOGIC SOIL PARAMETERS AFFECTED BY TILLAGE,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
For primary bibliographic entry see Field 4C.
W88-11072

HYDROLOGIC EFFECTS OF CONSERVATION TILLAGE AND THEIR IMPORTANCE RELATIVE TO WATER QUALITY,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 4C.
W88-11073

SOIL CHEMICAL AND BIOLOGICAL PROPERTIES AS AFFECTED BY CONSERVATION TILLAGE: ENVIRONMENTAL IMPLICATIONS,
Ohio State Univ., Wooster. Agricultural Technical Inst.
For primary bibliographic entry see Field 4C.
W88-11074

EFFECT OF CONSERVATION TILLAGE ON BIOLOGICAL AND CHEMICAL SOIL CONDITIONS: REGIONAL AND TEMPORAL VARIABILITY,
Kentucky Univ., Lexington.
For primary bibliographic entry see Field 4C.
W88-11075

EFFECTS OF CONSERVATION TILLAGE PRACTICES ON PESTICIDE VOLATILIZATION AND DEGRADATION,
Agricultural Research Service, Beltsville, MD.
For primary bibliographic entry see Field 4C.
W88-11076

EFFECT OF CONSERVATION TILLAGE ON PESTICIDE DISSIPATION,
Agricultural Research Service, Beltsville, MD.
For primary bibliographic entry see Field 4C.
W88-11077

PROCESSES INFLUENCING PESTICIDE LOSS WITH WATER UNDER CONSERVATION TILLAGE,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 4C.
W88-11078

EFFECTS OF CONSERVATION TILLAGE ON PESTICIDE LOSS WITH WATER,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 4C.
W88-11079

EFFECT OF CONSERVATION TILLAGE ON FATE AND TRANSPORT OF NITROGEN,
North Carolina State Univ., Raleigh.
For primary bibliographic entry see Field 4C.
W88-11080

EFFECT OF CONSERVATION TILLAGE ON PROCESSES AFFECTING NITROGEN MANAGEMENT,
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 4C.
W88-11081

MANURE MANAGEMENT WITH CONSERVATION TILLAGE,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 4C.
W88-11082

ASSESSMENT OF GREAT LAKES TILLAGE PRACTICES AND THEIR POTENTIAL IMPACT ON WATER QUALITY,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 4C.
W88-11083

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

WATER QUALITY CLASSIFICATION OF INLAND WATERS IN FINLAND,
National Board of Waters, Helsinki (Finland).
P. Heinonen, and S. Herve.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 147-156, 1987. 4 tab.

Descriptors: *Water quality, *Water quality standards, *Finland, Watercourses, Public waters, Raw water, Municipal water, Classification, Recreation, Fishing, Water quality management, Water use.

The Water Quality Classification System taken into trial use in Finland in the summer of 1985 is described in detail. This system contains three utilization-specific watercourse classifications, i.e., quality-based classification of watercourses for recreational purposes, raw water (for domestic use) classification and quality classification of watercourses for fishing. In addition to these utilization-specific classifications, the general water quality classification is also presented. Water quality classifications for each watercourse are termed excellent, good, satisfactory, poor, bad, and unsuitable, with criteria presented for each of these classifications in each watercourse type. (Author's abstract)
W88-10120

ATHIAS -- AN INFORMATION SYSTEM FOR ABIOTIC TRANSFORMATIONS OF HALOGENATED HYDROCARBONS IN AQUEOUS SOLUTION,
Stanford Univ., CA. Dept. of Civil Engineering.
W. Ellenrieder, and M. Reinhard.
Chemosphere CMSHAF, Vol. 17, No. 2, p 331-344, 1988. 5 fig, 2 tab, 19 ref. US EPA Grant CR-812462.

Descriptors: *Hydrocarbons, *Aliphatic Hydrocarbons, *Pollutant identification, *Data storage and retrieval, *Information exchange, *Information retrieval, Chemical reactions, Chemical degradation, Degradation products, Kinetics, Computer programs, Computers, Chemical properties, Hydrogen ion concentration, Thermal properties.

The kinetic data for the transformation reactions of haloaliphatic compounds in water have been critically reviewed. The kinetic constants have been compiled in ATHIAS, a microcomputer-based Lotus 1-2-3 worksheet that also contains literature citations, compound characteristics and reaction products. For facile data evaluations, the worksheet has been equipped with programs for rapid retrieval of data normalized to standard conditions, and for interactive data evaluation under user-specified temperature and pH conditions. The data base of ATHIAS contains (1) compound characteristics, (2) kinetic data for the abiotic decomposition of halogenated aliphatic compounds in aqueous solution, (3) the mathematical equations for the temperature- and pH-dependence of the rate data and (4) literature citations. Easy-to-use system functions are incorporated in ATHIAS for rapid data retrieval and data evaluation. These system functions provide a tool to rapidly access the stored information at standard conditions (25 C and pH 7) and to calculate the listed kinetic data at any specified condition (any temperature and pH). The system is menu-driven and provides self-explanatory on-screen instructions at every level of operation. To date, the data base in ATHIAS contains data for 58 haloaliphatic compounds. (Friedmann-PTT)
W88-10137

PITFALLS IN THE AQUATIC PHOTOCHEMISTRY TESTING OF CHLORINATED AROMATIC COMPOUNDS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Ecotoxicology, Environmental Chemistry, and Drinking Water.
P. van Noort, R. Smit, E. Zwaan, and J. Zijlstra.
Chemosphere CMSHAF, Vol. 17, No. 2, p 395-398, 1988. 2 fig, 13 ref.

Descriptors: *Aromatic compounds, *Chlorinated hydrocarbons, *Fate of pollutants, *Humic acids, *Irradiation, *Water analysis, *Photochemistry, Phototransformation, Hydrocarbons, Pollutant identification, Water properties, Acidic water, Organic compounds.

In this paper, eventual phototransformation of chloroaromatics in water containing humic acid is proposed to result from unidentified trace impurities in the water introduced by the addition of concentrated solutions of humic acid to the irradiation mixtures. Irradiation of aqueous humic acid solutions were carried out in a Rayonet Photchemical Reactor RPR 208 equipped with eight RUL-3500 angstrom lamps and a RMA-400 Merry-Go-Round. Results from the irradiation in the not-purified deionized water demonstrated that the addition of humic acid affords an acceleration of the disappearance by a factor of about 4. In the purified water, pentachlorobenzene did not disappear. In the presence of humic acid, pentachlorobenzene in the pre-irradiated, purified water was consumed to some extent. Humic acid itself did not seem to sensitize the phototransformation of chloroaromatics in water. (Friedmann-PTT)
W88-10139

BIOACCUMULATION OF HALOGENATED AROMATIC HYDROCARBONS IN C57B1/6 AND DBA/2 MICE FOLLOWING CONSUMPTION OF GREAT LAKES COHO SALMON (ONCORHYNCHUS KISUTCH),

McMaster Univ., Hamilton (Ontario). Dept. of Pathology.
For primary bibliographic entry see Field 5B.
W88-10140

TOXICOLOGICAL APPROACH FOR DETECTING ORGANIC MICROPOLLUTANTS IN ENVRIONMENTAL SAMPLES,
Istituto di Ricerca sulle Acque, Milan (Italy).
S. Galassi, C. Battaglia, and L. Vigano.
Chemosphere CMSHAF, Vol. 17, No. 4, p 783-787, 1988. 1 fig, 3 tab, 13 ref.

Descriptors: *Toxicity, *Pollutant identification, *Organic pollutants, *Surface water, *Water pollution effects, Ecosystems, Daphnia, Population exposure, Bioassay, Chromatography, River Po, Italy, River Lambro, Water pollution, Water sampling, Industrial pollution.

In this study, toxicological and analytical measurements were coupled to focus attention on those anthropogenic organic compounds present only in toxic samples. Surface waters from the Rivers Po and Lambro (Italy) were sampled and organic micropollutants were extracted from water samples by means of XAD-2 XAD-7 macroreticular resins. Concentrated extracts were tested for toxicity on Daphnia magna and analyzed by high performance liquid chromatography, gas-liquid chromatography (GLC), and gas chromatography/mass spectrometry techniques. The toxicological approach seems to be very promising for detecting the presence of micropollutants in surface waters. By comparing toxic and nontoxic extracts, it is possible to distinguish anthropogenic hazardous chemicals from compounds of natural origin or other widespread, but less hazardous, contaminants. Different toxic effects on a very sensitive aquatic organism could be observed from samples collected in different periods and locations. The most toxic samples contained the highest concentrations of some classes of organic compounds both of agricultural and industrial origin. However, the toxic effects observed on Daphnia magna could both be explained on the basis of analytical measurements. The contribution of compounds not volatile enough to be analyzed by GLC, too diluted to be identified by mass spectrometry or of chemical classes not under consideration should be considered in order to justify the observed global toxic effect. Therefore, analytical techniques commonly used for detecting organic micropollutants appear for the moment to be a less sensitive tool than ecotoxicological tests. (Friedmann-PTT)
W88-10153

MERITS OF MACROFAUNAL COLONIZATION OF INTERTIDAL MUDFLATS FOR POLLUTION MONITORING: PRELIMINARY STUDY,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
S. F. Thrush, and D. S. Roper.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 116, No. 3, p 219-233, May 24 1988. 5 fig, 3 tab, 37 ref.

Descriptors: *Monitoring, *Path of pollutants, *Colonization, *Macrofauna, *Water pollution effects, *Sediments, *Mud flats, Tidal flats, Benthic fauna, New Zealand, Manukau Harbor, Migration, Monitoring.

An experiment was conducted to test the hypothesis that initial macrofaunal colonization rates were similar except in polluted areas. Trays of azoic sediment were used to collect macrofauna after 20 days from six mudflats in Manukau Harbor, New Zealand. The densities of colonists were compared with densities in adjacent sediment and with sediment contaminant concentrations. Significant differences were recorded in the densities of macrofauna around the harbor. Few significant correlations were apparent between the abundance of colonists and sediment contaminant concentrations. On one highly polluted mudflat, a low density and low number of colonizing species were recorded. The experiment demonstrated that colonization into 150-mm diameter trays did not show a clear pattern of response to pollution. Trays were colonized primarily by adult migration rather than larval settlement. The experiment highlights the importance of movement by adult fauna in intertidal mudflat communities. (Author's abstract)
W88-10158

QUANTITATIVE ASSESSMENT OF WORLDWIDE CONTAMINATION OF AIR, WATER AND SOILS BY TRACE METALS,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W88-10164

DETERMINATION OF MO(VI) IN TAP WATER AND SEA-WATER BY DIFFERENTIAL-PULSE POLAROGRAPHY AND CO-FLOTATION,
Cadiz Univ. (Spain). Faculty of Sciences.
For primary bibliographic entry see Field 7B.
W88-10166

HYDROCARBONS IDENTIFICATION IN 'HUIRO' (MACROCYSTIS PYRIFERA) FROM THE STRAIT OF MAGELLAN (IDENTIFICACION DE HIDROCARBUROS EN HUIRO (MACROCYSTIS PYRIFERA) DEL ESTRECHO DE MAGALLANES),
Universidad de Magallanes, Punta Arenas (Chile). Inst. de la Patagonia.
O. Lecaros, J. Caro, and V. Munoz.
Revista de Biologia Marina (Valparaiso), Vol. 23, No. 2, p 215-229, December 1987. 7 fig, 2 tab, 7 ref (English summary).

Descriptors: *Water pollution sources, *Pollutant identification, *Hydrocarbons, *Algae, *Chemical analysis, Strait of Magellan, Gas chromatography, Thin layer chromatography, Tissue analysis, Fossil oil pollution, Path of pollutants, Chile.

Samples of the alga Macrocystis pyrifera from different sites along straits of Magellan (Chile) were analyzed for their normal paraffin distribution from n-C15H32 to n-C30H62. The procedure involves saponification of lipids and isolation of hydrocarbons, n-hexane extraction, silica gel chromatography and capillary gas chromatography. The results showed significant differences in the composition of algae studied and provided information related to possible fossil petroleum contamination. Hydrocarbons appear to be derived from biogenic terrestrial and marine sources as evidenced with a strong odd carbon preference in the n-alkanes. (Author's abstract)
W88-10201

BIO-INDICATORS AND THE MEANING OF DIATOM-BASED INDICES OF WATER QUALITY (BIO-INDICATEURS ET SIGNIFICATION DES INDICES DIATOMIQUES DE QUALITE DES EAUX,
Jardin Botanique National de Belgique, Meise.
R. Fabri.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 2, p 285-289, 1987. 1 fig.

Descriptors: *Diatoms, *Pollutant identification, *Water quality standards, *Bioindicators, *Oligotrophic waters, Water pollution.

Without references to natural situations, the evaluation of water quality with the help of bioindicators has no sense and frequently leads to underestimation of the pollution level, especially in oligotrophic waters (actual examples are chosen in high Ardenne, Belgium). (Author's abstract)
W88-10246

TWO NEW DIATOM-BASED INDICES AND THE CHEMICAL QUALITY OF RUNNING WATERS: COMPARISON WITH VARIOUS EXISTING INDICES (DEUX NOUVEAUX INDICES DIATOMIQUE ET DE QUALITE CHIMIQUE DES EAUX COURANTES: COMPARAISON AVEC DIFFERENTS INDICES EXISTANTS,
Centre de Recherche et d'Education pour la Conservation de la Nature, Verviers (Belgium).
L. Leclercq, and B. Maquet.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 2, p 303-310, 1987. 2 tab, 14 ref.

Descriptors: *Water quality, *Pollutant identification, *Bioindications, *Diatoms, *Nutrients, Aquatic populations, Species diversity, Biological properties, Water quality standards, Streams, Organic pollutants, Chemical properties, Comparison studies.

Several indices of chemical and biological water quality are compared and significance of the index values (sometimes very different according to the methods applied), necessity of the identification of all species, lack of precision of the biocenotic indices of Verneaux, and using higher identification levels (order, family or genus) are discussed. A new chemical index and a modification of the aprobic index based on diatoms are proposed. For the drainage basin of the Samson, chosen for its diversity, the estimate resulting from the simultaneous use of the authors' new indices is better than that of the other methods. Owing to the direct reaction to organic pollutants used as nutrients by some species, diatoms give more precise and valid indication than benthic macroinvertebrates communities which are more influenced by substrate or current conditions. (Author's abstract)
W88-10247

CADMIUM IN THE RHONE RIVER,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5B.
W88-10265

CONCENTRATION OF VIRUSES FROM WATER ON BITUMINOUS COAL,
National Environmental Engineering Research Inst., Nagpur (India).
S. B. Lakhe, and N. M. Parhad.
Water Research WATRAG, Vol. 22, No. 5, p 635-640, May 1988. 8 tab, 31 ref.

Descriptors: *Water analysis, *Viral analysis, *Adsorption, *Viruses, *Coal, *Water treatment, Cations, Poliovirus, Hydrogen ion concentration, Aluminum, Human diseases.

The potential of bituminous coal for adsorption of viruses, using poliovirus as a model, was investigated. Influence of pH of water on the adsorption of viruses on a coal bed with and without addition of cation ($Al(+++)$) indicated that poliovirus could be adsorbed efficiently at pH 5 in presence of $AlCl3$ at a concentration of 0.0005 M. Studies on the effect of different concentrations of monovalent, divalent and trivalent cations showed that the trivalent cation was the most effective and was required at a lower concentration than other cations tested. A coal bed of 1.5 g could adsorb as high as 204,000 plaque-forming units from water based on the absence of virus in the filtrate. The total organic carbon content (21-51 mg/L) of the water did not interfere in virus adsorption to coal. The results obtained indicated that a bituminous coal bed could be used as one of the methods for efficient concentration of viruses from water. (Author's abstract)
W88-10273

ANTIBIOTIC RESISTANCE AMONG POLLUTION INDICATOR BACTERIA ISOLATED FROM AL-KHAIR RIVER, BAGHDAD,
Biological Research Center, Baghdad (Iraq).
For primary bibliographic entry see Field 5B.
W88-10274

PROGRESSIVE MODIFICATIONS IN THE STRUCTURE OF BENTHIC INVERTEBRATE COMMUNITIES AS A FUNCTION OF WATER QUALITY OF THE OURTHE AND LESSE (BELGIAN MEUSE) (MODIFICATION PROGRESSIVE DE LA STRUCTURE DES PEUPLEMENTS D'INVERTEBRES BENTHIQUES EN

FONCTION DE LA QUALITE DE L'EAU DE L'OURTHE ET LA LESSE (MEUSE BELGE)),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. de Biologie Quantitative.
E. Depiereux, and E. Feytmans.
Acta Oecologia, Oecologia Applicata AOSADN, Vol. 6, No. 2, p 81-98, February 1985. 10 fig, 2 tab, 27 ref.

Descriptors: *Bioindicators, *Water quality, *Benthos, *Data interpretation, *Invertebrates, *Eutrophication, *Water pollution effects, Classification, Cluster analysis, Belgium, Ourthe River, Lesse River, Artificial substrates, Rivers, Principal component analysis.

Cluster analysis and principal component analysis are related techniques for the analysis of benthic invertebrate samples. A histogram of the abundance of the taxa is based on the classification automatically obtained from principal components analysis. This profile shows the structure of the community and provides a powerful tool for the interpretation of the results. Invertebrate samples obtained in the basins of the Ourthe and Lesse Rivers, Belgium, along a gradient of progressive eutrophication were analyzed. The interpretation of the results obtained with the small hoop-net sampler (0.5 mm mesh) permits the characterization of three groups of samples, each one related to a typical biological profile. The profiles are correlated to different levels of a water quality gradient, according to the sensitivity of the most abundant species. The samples are thus classified between pollution and eutrophication and the two types of environmental changes are perfectly differentiated. Codification of the data with Chandler's classes of abundance does not modify the results of principal component analysis. The sampling of experimental data may be considerably simplified without any limitation of the interpretation. Interpretation of results obtained with the hoop-net sampler generally agrees with those obtained by the colonization of artificial substrates. No bias of the sampling technique was found to modify the interpretation of the results. (Author's abstract)
W88-10280

USE OF VERTICAL SNOW SAMPLING AS AN INDICATOR OF SOME EMISSIONS FROM POINT SOURCES,
Insinoori- ja Limnologitoimisto Oy Vesitekniikka A.B., Salpakangas (Finland).
M. Ettala, E. Kukkamaki, and A. Tamminen.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 91-108, 1987. 10 fig, 9 tab, 23 ref.

Descriptors: *Snow sampling, *Fallout, *Water pollution, Water pollution sources, *Air pollution, *Path of pollutants, Inorganic compounds, Dusts, Chromium, Iron, Particulate matter, Mosses, Point sources, Finland, Vertical sampling, Water soluble compounds.

The deposition of dust emissions was measured and analyzed by vertical sampling from the snowpack. The target was to develop further the method presented by Soveri to determine the environmental loading of a point source and the area affected. The first point source studied emitted inorganic dust, including chrome and iron. A fairly good correlation was found between the emission and the environmental load. The percentages of known emission determined by snow sampling were: inorganic deposit about 80%, chrome deposit about 50% and iron deposit about 60%. The deposit measured from snow sampling was about 1.5 times as high as that measured with standard-horizontal deposition gauges. The second point source studied emitted water-soluble compounds. The snow method seemed to be suitable for determining such compounds as well as the nutrient load or defined water bodies. Open fields were found to be unsuitable for sampling because of the free horizontal movement of the snow. The number of subsamples required for each sample depends on how large an error can be accepted in the result. A very significant correlation was found between the results of analyses of snow samples and biological material (the mosses Hylocomium splendens and Pleurozium schreberi). (Author's abstract)
W88-10296

EFFECTS OF FILTRATION ON THE DETERMINATION OF PHOSPHATE PHOSPHORUS IN RUNOFF WATERS,
National Board of Waters, Helsinki (Finland).
S. Herve, and L. Kauppi.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 151-155, 1987. 2 fig, 3 tab, 13 ref.

Descriptors: *Filtration, *Water analysis, *Chemical analysis, *Phosphorus, *Turbidity, Catchment basins, Finland, Molybdenum, Eutrophication, Pollutant identification, Reactive phosphorus.

The effect of filtration on the phosphate concentrations in runoff waters in two different drainage basins under varying discharge conditions was studied. Soluble reactive phosphorus concentrations were determined using different types of filters. Filtration clearly decreased the amount of phosphorus reacting with molybdenum in turbid samples. The results with the GF/C filter and 0.45 micron membrane were very similar, but the black ribbon filter (pore size 7.4 microns) gave a much smaller reduction in reactive phosphorus concentrations. In cases where the relevant phosphorus fraction is the phosphorus available to algae, soluble reactive phosphorus seems to provide a reasonable estimate. Measuring total reactive phosphorus very likely overestimates the level of available phosphorus in turbid waters because of the rather severe acid treatment included in the method. (Author's abstract)
W88-10300

STRONG AND WEAK ACIDS IN LAKE WATERS - A METHODOLOGICAL STUDY,
National Board of Waters, Helsinki (Finland). Water Research Inst.
P. Kortelainen, J. Mannio, and I. Makinen.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 221-229, 1987. 4 fig, 2 tab, 27 ref.

Descriptors: *Acids, *Water analysis, *Chemical analysis, *Surface waters, *Acid rain, *Hydrogen ion concentration, *Organic acids, *Mineral acids, Coulometric Gran titration, Lakes, Mineral acids, Pollutant identification.

When considering the acidification of surface waters, it is important to distinguish between strong mineral acidity and natural organic acidity. This methodological study concentrated mainly on testing the applicability of the coulometric Gran titration over a wide pH range to the analysis of strong and weak acids in lake waters. Of critical importance is a low enough starting pH of the titration. However, if the pK(2) values of the organic acids are very low, it is difficult to separate them from the strong mineral acids. The material consisted of samples from 26 lakes with pH values ranging from 4.47 to 7.80 and the total organic carbon from 0.4 to 38.8 mg/l. Strong acids were observed when the pH of the samples was $<$ or $=$ 4.9 (n=7). When the pH was $>$ or $=$ 5.1 (n=19) the strong acid concentration became negative corresponding to the content of free bases. The free acidity of the samples with pH values $<$ or $=$ 4.9 was largely explained by total organic carbon, silica and aluminum concentrations. Strong and weak acid determinations, as well as ion balance calculations, are being continued in a larger lake material with seasonal sampling in order to estimate the contribution of organic matter to the acidity of natural waters. (Author's abstract)
W88-10307

APPLICATION OF REMOTE SENSING TECHNIQUES FOR WATER QUALITY MONITORING,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 7B.
W88-10345

CHEMICAL REACTIONS OF OZONE AND THEIR ROLE IN DEVELOPING IMPROVED ANALYTICAL METHODS,
Miami Univ., Oxford, OH. Dept. of Chemistry.
G. Gordon, G. E. Pacey, W. J. Cooper, and R. G. Rice.
Ozone: Science and Engineering OZSEDS, Vol. 10, No. 1, p 89-102, Winter, 1988. 1 tab, 32 ref.

Descriptors: *Chemical reactions, *Ozone, *Chemical analysis, *Water treatment, Indigo method, Water analysis, Ozonation, Automation, Decomposition, Kinetics.

Most methods for the determination of ozone were developed by utilizing existing methods for chlorine determination, with or without modifications, despite the fact that ozone chemistry is very different from chlorine chemistry. The ozone decomposition mechanism is therefore described in order to help in the development of selective methods for ozone. The specific role of highly reactive intermediates of other interferents, such as transition metal ions, is emphasized, and the concept of an 'Ideal Method' is introduced. This method would measure the concentration of aqueous ozone accurately in all types of water samples and be interference-free, with a selectivity factor greater than 500 and a detection limit of less than 0.1 mg/l with a precision of 0.1% and an accuracy of 0.5%. This idealized analytical method will allow individual comparisons and the choice between various methods based on shortcomings of individual methods. The indigo method is examined as such a method. Moreover, automation of this method by using flow injection brings improvement in terms of higher linear range, greater precision among samples, higher sampling frequency, and lower reagent consumption. (Doria-PTT)
W88-10384

BLINK REFLEX LATENCY AFTER EXPOSURE TO TRICHLOROETHYLENE IN WELL WATER,
Boston Univ., MA. School of Medicine.
R. G. Feldman, J. Chirico-Post, and S. P. Proctor.
Archives of Environmental Health AEHLAU, Vol. 43, No. 2, p 143-148, March/April 1988. 3 fig, 2 tab, 52 ref.

Descriptors: *Trichloroethylene, *Chlorinated hydrocarbons, *Water pollution effects, *Blink reflex, *Population exposure, *Toxicity, *Well water, Hydrocarbons, Groundwater pollution, Human physiology, Public health, Drinking water, Contamination.

A study was conducted to assess the value of the blink reflex (BR) measurement as an objective indicator of neurotoxic effects in a population exposed to trichloroethylene through their public drinking water source. The electrophysiological measurement of the blink reflex can quantify the conduction latency in the reflex arc involving the Vth (trigeminal) and VIIth (facial) cranial nerves. The electrophysiological BR was measured in a population ($N = 21$), which had alleged chronic exposure to trichloroethylene (TCE) through the public drinking water at levels 30-80 times higher than the Environmental Protection Agency Maximum Contamination Level. A highly significant difference was observed in the conduction latency means of the BR components ($p < .0001$), when the study population was compared with laboratory controls ($N = 27$). This difference suggests a subclinical alteration of the Vth cranial nerve function due to chronic, environmental exposure to TCE. (Author's abstract)
W88-10389

ALKALINITY IN SURFACE WATER ACIDIFICATION STUDIES: A COMPARISON OF TWO METHODS,
North East River Purification Board, Aberdeen (Scotland).
K. B. Pugh.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 3, p 321-323, June 1988. 1 fig, 1 tab, 3 ref.

Descriptors: *Acid rain, *Alkalinity, *Acid streams, *Chemical analysis, *Water analysis, *Titration, Rainfall, Chemical properties, Comparison studies, Acidic water, Quality control, Sulfuric acid, Chemistry, Reagents, Spey River, Dee River, Scotland, Errors, Accuracy, Correlation analysis.

An interest in the possible acidification of surface waters in the upper tributary drainage basins of the River Spey and River Dee in northeastern Scotland prompted an examination of the recommended methods of alkalinity determination. On eight monthly occasions, samples from the study sites were subjected to alkalinity determination by two methods: (1) titration with N/200 sulfuric acid using methyl orange plus xylene cyanol FF to indicate the endpoint; and (2) titration with N/200 sulfuric acid using an electrode system to allow a two-point (pH 4.5 and 4.2) Gran-type plot determination. The linear correlation of the two methods was calculated. A highly significant relationship was derived, but the methyl orange method consistently overestimated the alkalinity, by as much as 5 mg CaCO3/l. The data illustrate and confirm reservations previously expressed on methods in acidification studies, demonstrate the importance of method selection, and underline the need for strict adherence to the fine detail of practical procedures to ensure consistency of performance within and between batches of analyses. (Doria-PTT)
W88-10404

IDENTIFICATION AND QUANTIFICATION OF VOLATILE ORGANIC SPECIES DURING MICROBIAL TREATMENT OF LEACHATE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5D.
W88-10405

USE OF THE PLANARIAN DUGESIA TIGRINA GIRARD FOR THE ASSESSMENT OF CHRONIC INTOXICATIONS,
Wyzsza Szkola Inzynierska, Zielona Gora (Poland). Inst. of Sanitary Engineering.
A. Solski, and M. Piontek.
Polskie Archiwum Hydrobiologii PAHYA2, Vol.34, No. 4, p 543-550, 1987. 3 tab, 23 ref.

Descriptors: *Toxicity, *Planaria, *Bioassay, *Water pollution effects, *Platyhelminthes, *Bioindicators, Ammonium oxalate, Regeneration, Mortality, Life cycles, Median tolerance limit, Ammonium compounds, Para-cresol, Cobaltous nitrate, Lethal limit, Dugesia, Pollution identification.

Dugesia tigrina Girard was used in chronic toxicity studies. Using the ability of D. tigrina to regenerate, we have artificially multiplied (through body cutting in two parts) the population of this species. Cut individuals were considered as the successive 'generation'; so they were the animals which, following regeneration and growth to the original size of 11-12 mm, were cut again. The effect of three substances: ammonium oxalate, p-cresol and cobaltous nitrate, on four 'generations' of planarians was studied. Population of D. tigrina remained for 80 days in a toxic environment, in known concentrations of the substances studied. The values of these concentrations were based on the previously found allowable concentrations: LC50 (240 hrs) times the safety coefficient (0.1 and 0.01). The 240-hr LC50 was 13.85 mg/L for ammonium oxalate, 11.08 mg/L for p-cresol, and 3.49 mg/L for cobaltous nitrate; the allowable concentrations were 1.4 mg/L, 1.0 mg/L and 0.035 mg/L, respectively. For each substance five dilutions were prepared; one equal to the allowable concentration, and twice and four times lower or higher than the allowable concentration. Concentrations of the substances four times higher than the allowable concentration were lethal to D. tigrina; twice higher were lethal in varying degrees, while those equal to the allowable concentration or lower were not-toxic. Cobaltous nitrate was found to be a potent poison since its concentration of 0.14 mg/L was lethal to all animals of the second 'generation'. (VerNooy-PTT)
W88-10435

ASSESSMENT OF ROKANOL TOXICITY TO A POPULATION AND TO AN AQUATIC ECOSYSTEM,
Wyzsza Szkola Inzynierska, Zielona Gora (Poland). Inst. of Sanitary Engineering.
For primary bibliographic entry see Field 5C.
W88-10436

ANALYSIS OF DICAMBA FROM WATER USING SOLID-PHASE EXTRACTION AND ION-PAIR HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,
Pennsylvania State Univ., University Park. Pesticide Research Lab.
M. Arjmand, T. D. Spittler, and R. O. Mumma.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 36, No. 3, p 492-494, May/June 1988. 3 fig, 3 tab, 6 ref. Northeast Region Research Project NE-115.

Descriptors: *Chromatography, *Pollutant identification, *Chemical analysis, *Herbicides, Organic compounds, *Water analysis, Ion exchange, Organic solvents, Acidic water, Methylation.

Dicamba (3,6-dichlor-2-methoxybenzoic acid) is a postemergence herbicide used for control of broadleaf weeds and is traditionally analyzed by extraction from acidic aqueous solutions with organic solvent, subsequent methylation, and analysis by gas chromatography. A simple, inexpensive procedure for analysis of dicamba and its metabolite (3,6-dichlorosalicylic acid) from water has been developed involving solid-phase extraction with amino ion-exchange columns, elution with a salt solution, and subsequent analysis with high performance liquid chromatography utilizing ion-pair elution techniques on reversed-phase columns. The procedure is sensitive (1.6 ppb) and applicable to multiple samples, eliminates the need for costly and environmentally hazardous solvents, and does not require any solvent evaporation steps. (Author's abstract)
W88-10459

DETERMINATION OF POLYCHLORINATED BIPHENYLS IN SEDIMENTS, USING SONICATION EXTRACTION AND CAPILLARY COLUMN GAS CHROMATOGRAPHY-ELECTRON CAPTURE DETECTION WITH INTERNAL STANDARD CALIBRATION,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
F. M. Dunnivant, and A. W. Elzerman.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 71, No. 3, p 551-556, May/June 1988. 2 fig, 2 tab, 30 ref. NSF Grant ISP8011451.

Descriptors: *Chromatography, *Sonication, *Chemical analysis, *Polychlorinated biphenyls, *Sediments, Water pollution, Organic compounds, Pollutant identification, Ultrasound, Soxhlet extraction, Quantitative analysis.

A sonication technique is presented for the extraction of polychlorinated biphenyls (PCBs) from sediments. In addition, a quantitation scheme is described that allows peak-specific and, in many cases, congener-specific determination of PCBs. PCBs are quantitated by capillary column gas chromatography-electron capture detection, with internal standard calibration. Results utilizing sonication extraction were compared with those obtained by Soxhlet and steam distillation extractions of 3 U.S. Environmental Protection Agency (EPA) quality control sediment samples and 3 lake sediments known to be contaminated with PCBs. Environmental lake sediments were extracted wet, with no drying prior to extraction. Recoveries by each technique varied depending on the sediment sample being extracted and degree of chlorination of PCB congeners. With proper selection of extraction solvent, the sonication technique can recover amounts of PCBs equivalent to and sometimes greater than recoveries by the Soxhlet or steam distillation techniques. A 24-h quiescent period in the extraction solvent between 2 sonications improved extraction efficiency for 2 freeze-dried sediments but did not affect results obtained for 3 environmentally contaminated sediments that were extracted without drying. Replacement of Soxhlet extraction with the sonication technique results in reduced sample preparation time, decreased volumes of solvents and sample, and substitution of glassware. Sonication extraction can also improve precision compared with Soxhlet extraction. (Author's abstract)
W88-10460

IDENTIFICATION OF ESCHERICHIA COLI FROM SHELLFISH AND RELATED ENVIRONMENTS BY AUTOMICROBIC SYSTEM,
Food and Drug Administration, Baltimore, MD. Baltimore District Office.
J. L. Tardio, K. O'Brien, and T. Latt.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 71, No. 3, p 582-584, May/June 1988. 2 tab, 10 ref.

Descriptors: *Pollutant identification, *Shellfish, *Automation, *Bacterial analysis, *Escherichia coli, Bacteria, Chemical analyis, Population exposure, Autoanalyzers.

A total of 463 fecal coliform positive isolates obtained from shellfish and related samples gave typical Escherichia coli IMViC reactions. E. Coli identifications for 458 (99%) of these isolates were confirmed using a combination of the Automicrobic System (AMS) and the API 20E system (reference system). The AMS (test system) identified 433 isolates as E. coli; the remaining 25 (5%) isolates were identified as E. hermanii by the test system and as E. coli by the reference system. Additional tests performed on the isolates identified as E. hermanii confirmed those AMS identifications to be incorrect. (Author's abstract)
W88-10461

VARIABILITY IN THE SPERMATHECAL SETAE OF POTAMOTHRIX HEUSCHERI (BRETSCHER) (OLIGOCHAETA, TUBIFICIDAE) IN LAKE NEMI AND NOTES ON THE RELATIONSHIP BETWEEN THIS SPECIES AND THE TROPHIC LEVEL OF LAKES (VARIABILITE DES SOIES SPERMATHECALES DE POTAMOTHRIX HEUSCHERI (BRETSCHER) (OLIGOCHAETA, TUBIFICIDAE) DANS LE LAC DE NEMI ET REMARQUES SUR LA RELATION ENTRE CETTE ESPECE ET LE DEGRE DE TROPHIE DES LACS),
Rome Univ. (Italy). Dept. of Animal and Human Biology.
For primary bibliographic entry see Field 2H.
W88-10464

GEOCHEMISTRY OF THE RHINE AND THE RHONE. 5: SYNTHESIS AND CONCLUSIONS (GEOCHIMIE DU RHIN ET DU RHONE. 5: SYNTHESE ET CONCLUSIONS),
Station Biologique de la Tour du Valat, Arles (France).
H. L. Golterman.
Annales de Limnologie ANLIB3, Vol. 21, No. 3, p 191-201, 1985. 3 fig, 4 tab, 11 ref.

Descriptors: *Rivers, *Rhine River, *Rhone River, *Solute transport, *Path of pollutants, *Water pollution sources, *Geochemistry, Acidic water, Minerals, Chemical properties, Hydrogen ion concentration, Calcium, Mineral water, Carbonates, Sulfates, Phosphates, Calcium sulfate, Europe, Data collections, Solubility, Buffering capacity, Temperature, Monitoring.

Every month, 2 samples of the Rhine and 1 sample of the Rhone are analyzed for about 20 chemical and physical variables at 7 stations by two monitoring agencies. Some of conclusions on the accuracy of these programs and on the solubility of the calcium/carbonate/sulfate/phosphate system are presented. In total 916 data sets were analyzed; they were screened for imprecision before being used. At all stations, the water is saturated with CaCO3, but the apparent solubility product depends on the pH. The regression line can be described by the ionic product of calcium carbonate = 8.73 x 10 to the minus 15th power times pH to the 15.667 power. In both the Rhine and Rhone, an acidification is seen and an increase of the sulfate concentration when going downstream. The increase in sulfate concentration is due to the disposal of CaSO4. This addition of sulfate influences the quotient Ca/HCO3. The data fit very well the theoretical regression line Ca/HCO3 = 0,5(SO4) + 0.5. The acidification originates from the miner-

alization of organic matter. For 6 stations downstream from the great lakes, the two rivers are saturated with hydroxy-apatite, the log of the ionic product being 49.4 (Rhine; sigma = 0.6; N = 259) and 50.0 (Rhone; sigma = 0.3; N = 479). The o-phosphate concentration does not therefore depend on the phosphate loading of the rivers, but on the Ca concentration, the temperature and the pH. This has great influence on the transport of phosphate through the deltas of the two rivers. The disturbance of acidity and buffering capacity influences heavy metal behavior as well. (Author's abstract)
W88-10469

MOLLUSKS OF TIGNES LAKE (SAVOIE): THEIR USEFULNESS IN CHARACTERIZING WATER QUALITY IN HIGH ALTITUDE LAKES (LES MOLLUSQUES DU LAC DE TIGNES (SAVOIE): INTERET DE CE GROUPE FAUNISTIQUE POUR CARACTERISER LA QUALITE BIOLOGIQUE DES SEDIMENTS DES LACS D'ALTITUDE,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France).
J. Mouthon.
Annales de Limnologie ANLIB3, Vol. 22, No. 2, p 133-136, 1986. 1 fig, 2 tab, 8 ref.

Descriptors: *Mollusks, *Water quality, *Mountain lakes, *Bioindicators, *Tignes Lake, Lakes, Quantitative analysis, Mapping, France, Water pollution, Littoral environment, Ecology.

A quantitative and qualitative inventory of the littoral and profundal molluska of Tignes lake (2086 m elevation, France) allows polluted areas to be readily delineated. Physico-chemical data were determined for water at various depths in the lake and the distribution of molluscan species was analyzed. These data made it possible to map the disturbed areas of the lake. (Author's abstract)
W88-10477

GENERAL PRINCIPLES FOR A METHOD OF ASSESSING THE OVERALL QUALITY OF LACUSTRINE SEDIMENTS, USING A SIMPLIFIED ANALYSIS OF THE MOLLUSK COMMUNITY,(PRINIPES GENERAUX POUR UNE METHOD D'APPRECIATION DE LAT QUALITE GLOBALE DES SEDIMENTS LACUSTRES A L'AIDE D'UNE ANALYSE SIMPLIFIEE DES MALACOCENOSES),
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France).
J Mouthon.
Annales de Limnologie ANLIB3, Vol. 22, No. 3, p 209-217, 1986. 2 fig, 2 tab, 43 ref.

Descriptors: *Mollusks, *Bioindicators, *Pollution index, *Lakes, *Lade sediments, *Population dynamics, Model studies, Animal populations, Aquatic habitats, Aquatic populations, Limnology, Data collections, Water quality standards.

Three general phenomena established form observations of molluscan communities in 30 European lakes can be used to describe a progressive degradation in the mollusk populations. The three phenomena are: (1) potential colonization of the profundal zone; (2) progressive abandonment of the profundal sediments; and (3) inversions of populations of bivalves and gastropods in the littoral and profundal zones. A model with seven successive situations is proposed to describe the progressive deterioration of the molluscan communities and to serve as an overall method of assessment for the biogenic capacity of lacustrine sediment. (Friedmann-PTT)
W88-10479

PLANKTON, CHLOROPHYLL CHARACTERISTICS AND FISHERY POTENTIAL OF SURFACE COAL MINE LAKES IN WESTERN PENNSYLVANIA,
Grove City Coll., Pa. Dept. of Biology.
F. J. Brenner, J. Edmundson, M. Werner, and T. McGrath.
Proceedings of the Pennsylvania Academy of Science PPASAK, Vol. 61, No. 2, p 147-152, 1987. 4 fig, 7 tab, 43 ref. Department of the Interior, Office of Water Research Grants 14-31-001-4038 and 14-34-0001-6039.

Descriptors: *Limnology, *Plankton, *Chlorophyll a, *Fisheries, *Coal mines, *Lakes, Pennsylvania, Species diversity, Population density, Biomass, Algae, Phytoplankton, Zooplankton, Fish populations, Chemical properties, Reclamation.

A survey was conducted on 138 surface mine lakes of various ages located on 81 surface mines in Mercer County, Pennsylvania. Of the lakes studied, only 18 had a pH of 6.4 or lower with the remainder having pH between 6.5 and 8.5. Based on this initial survey, 60 mines were selected for more detailed studies of the water chemistry, plankton communities, chlorophyll a concentrations and fish populations. These lakes supported 58 and 48 different phytoplankton and zooplankton taxa, respectively, as well as abundant fish populations. There was a linear correlation between algae biomass and chlorophyll a concentration/liter and both of these variables were correlated with the density and diversity of phytoplankton communities. In addition, correlations existed between the density and diversity of phytoplankton, as well as among the different water chemistry variables. The inclusion of lakes into reclamation plans should be encouraged wherever site conditions permit. (Author's abstract)
W88-10514

BENTHIC MACROINVERTEBRATES AS INDEXES OF WATER QUALITY IN THE UPPER CUYAHOGA RIVER,
Akron Univ., OH. Dept. of Biology.
J. H. Olive, J. L. Jackson, J. Bass, L. Holland, and T. Savisky.
Ohio Journal of Science OJSCA9, Vol. 88, No. 3, p 91-98, June 1988. 1 fig, 5 tab, 40 ref.

Descriptors: *Stream biota, *Population density, *Bioindicators, *Cuyahoga River, *Ohio, *Benthos, *Water quality, *Macroinvertebrates, Invertebrates, Rivers, Midges, Domestic water, Oligochaetes, Organic wastes.

The results of a benthic macroinvertebrate assessment of water quality in 1986 from nine areas along the upper Cuyahoga River in northeastern Ohio are reported. Indexes of water quality indicate a wide range in water quality along the river, but overall water quality is relatively high compared to areas of the Cuyahoga River below Akron and to most nearby river systems. Highest quality areas are located in the most headwater region and in the lowermost region near Lake Rockwell. These areas are characterized by a large number of taxa (> 50), moderate density of organisms (approximately 2000 per sq m), high ratios of scraper-grazers to detritivores (> 0.5), high ratios of amphipods to isopods, and less than 1% organic pollution-tolerant organisms. Moderate degradation of water quality due to organic sedimentation in these areas is indicated by large proportions of organic pollution-facultative organisms (27-66%), especially a great variety of chironomids. Lowest quality areas occur 1-2 km below wastewater outfalls from small villages and below groups of rural streamside dwellings. These areas are characterized by up to 62% fewer species, very low ratios of amphipods to isopods (usually < 2) and large proportions of organic pollution-facultative and tolerant organisms (43-95%) especially chironomids and oligochaetes. (Author's abstract)
W88-10515

EFFECTS OF HEAVY METALS ON LIPID METABOLISM IN MARINE ALGAE,
University Coll., Cardiff (Wales). Dept. of Biochemistry.
A. L. Jones, and J. L. Harwood.
Biochemical Society Transactions BCSTB5, Vol. 16, No. 3, p 275-276, June 1988. 1 tab, 5 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Heavy metals, *Metabolism, *Algae, Marine algae, Water pollution, Copper, Cadmium, Fatty acids.

In an effort to test the possibility of using algae as monitors for coastal and marine estuarine heavy pollution, the effects of Cu(+2) and Cd(+2) on five algal species were studied. Species included F. veiculosus, A. nodosum, C. crispus, P. lanosa, and E. intestinalis. No consistent trend was found in any of the algae to raised levels of Cu(+2) or Cd(+2). The red and green algae had raised tissue levels of Cu(+2) and Cd(+2) after incubation with these metals in vitro, but this appeared to have no effect on their lipid metabolism, and no effects were seen on the distribution of label among the complex lipids in any of the algae studied. (Miller-PTT)
W88-10517

POLAROGRAPHIC DETERMINATION OF CHROMIUM IN AQUEOUS MATRICES AT MICRO LEVELS,
Jodhpur Univ. (India). Dept. of Chemistry.
P. Sharma, and R. C. Kapoor.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 1/2, June 1987. 4 fig, 6 ref. Indian Ministry of Defence Sanction DTT/80843/50/RD-82/719/D(R&D).

Descriptors: *Wastewater analysis, *Pollutant identification, *Groundwater pollution, *Industrial wastewater, *Chemical analysis, *Polarographic analysis, *Chromium, Heavy metals, Water analysis, India, Voltammetry.

Concentrations of toxic metals should be monitored in industrial wastewater. A polarographic method is proposed for the determination of chromium, specifically in industrial wastewater samples of Jodhpur (India). The polarographic reduction of chromium(VI) was studied by DC polarography, differential pulse polarography (DPP) and cyclic voltammetry. Conditions have been standardized for analysis of ppm concentration of chromium in aqueous matrices by the DPP technique. (Brock-PTT)
W88-10519

EVALUATION OF COMBINED FLOW INJECTION-HIGH PERFORMANCE LIQUID CHROMATOGRAPHY FOR THE DETERMINATION OF THREE ORGANOPHOSPHORUS PESTICIDES IN LIQUID WASTES.
Instituto de Quimica Bio-Organica, Barcelona (Spain).
A. Farran, and J. De Pablo.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 1/2, June 1987. 6 fig, 10 ref.

Descriptors: *Organophosphorus pesticides, *Pesticide residues, *Industrial wastewater, *Chemical analysis, *Pollutant identification, *Chromatography, Liquid wastes, Diazinon, Azinphos-methyl, Fenthion, Spain, Pollutants, Flow injections.

Separation and analysis of a mixture of diazinon, azinphos-methyl and fenthion were studied using HPLC (high-performance liquid chromatography) with a UV detector. In order to carry out this analysis in a simple and rapid way, a system of flow injection (FIA) has been connected to the HPLC apparatus. This combined technique has shown great possibilities in the analysis of pesticides. (Brock-PTT)
W88-10520

STUDY OF AN EXTRACTION PROCEDURE FOR ORGANIC TRACE LEVELS: SOME RESULTS CONCERNING HYDROCARBONS IN MARINE SEDIMENTS.
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Chimique.
G. Morel, and P. Courtot.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 1/2, June 1987. 10 fig, 4 tab, 33 ref.

Descriptors: *Trace levels, *Pollutant identification, *Marine sediments, *Hydrocarbons, *Chemical analysis, *Adsorption, Gas chromatography,

Infrared spectroscopy, Extraction procedure, Organic trace levels.

A procedure for analysis of hydrocarbons in sediments is described that offers optimal operational simplicity. The yield (92%) of the extraction technique by mechanical stirring determined from the isotherm method of Freundlich, the accuracy of the results (94%), the sensitivity at the ppm level from infrared spectroscopy, at the hundred ppt level from GC2 (gas chromatography) and also the universal application of this method tested by comparison with other laboratories, make this an interesting technique for trace analysis. Results concerning the adsorption of hydrocarbons according to sediment characteristics are presented and the influence of the organic matter originally present is discussed. (Author's abstract)
W88-10521

SHALLOW-PROBE SOIL-GAS SAMPLING FOR INDICATION OF GROUND-WATER CONTAMINATION BY CHLOROFORM,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
H. B. Kerfoot.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 3, July 1987. 5 fig, 2 tab, 7 ref.

Descriptors: *Groundwater pollution, *Pollutant identification, *Soil gases, *Chloroform, *Chemical analysis, Volatility, Volatile organic compounds, Sampling, Field tests, Soil contamination, Variability.

Soil-gas sampling and analysis were field-tested for indication of groundwater contamination by chloroform. The field testing included evaluation of the repeatability of results, the correlation of results of soil-gas analyses with groundwater concentrations, the differences in results among closely spaced samples, and the depth profile of chloroform concentrations in soil-gas samples. The sampling probe gave good repeatability, although leakage of sample from syringes between sampling and analysis is postulated as a reason for variability in results. Soil-gas concentrations correlated with groundwater data at a level above 95% significance. Short-range variability of results ranged from 12% to 43% over 2 m with leakage of sample from syringes postulated as a reason for the higher variability. A depth-dependence of the chloroform concentration consistent with a vertical transport mechanism of gas-phase diffusion was observed. (Author's abstract)
W88-10523

ORGANIC POLLUTANTS IN WATER: I. OPTIMIZATION OF OPERATIONAL PARAMETERS OF THE CLSA TECHNIQUE,
Instituto de Quimica Bio-Organica, Barcelona (Spain). Dept. of Environmental Chemistry.
J. I. Gomez-Belinchon, and J. Albaiges.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 3, July 1987. 5 fig, 5 tab, 13 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Volatile organic compounds, Closed-loop stripping analysis, Volatility, Water pollution, Surveys, Temperature effects, Chlorinated hydrocarbons, Alkanes, Aromatic compounds.

The closed-loop stripping analysis (CLSA) is a well established method for quantitative determination of volatile organic pollutants in water. However, little attention has been paid to the reduction of the analysis time for a better application in monitoring studies. To this end extraction efficiencies with respect to compound volatility, water temperature (30, 35, 45 and 55 C) and time (0.5 and 2 hr) were calculated for a series of n-alkanes, alkylaromatics and chlorinated hydrocarbons. The stripping at 45 C during 0.5 hr gave better performances than the conventional 35 C/2 hr, thus representing suitable conditions for large survey studies. Some applications as well as the overcoming of background contamination are discussed. (Author's abstract)
W88-10524

SPECIATION OF CHROMIUM IN WATERS BY COPRECIPITATION-AAS,
Instituto de Quimica Bio-Organica, Barcelona (Spain).
J. Obiols, R. Devesa, J. Garcia-Berro, and J. Serra.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 3, July 1987. 5 fig, 2 tab, 8 ref.

Descriptors: *Water analysis, *Pollutant identification, *Atomic absorption spectrometry, *Chemical analysis, *Carcinogens, *Chromium, Heavy metals, Water pollution, Hydrogen ion concentrations, San Reservoir, Spain.

An analytical scheme for chromium speciation by coprecipitation with lead salts-AAS (atomic absorption spectrometry) is described. It allows the partitioning of the total concentration of the metal into four fractions: Cr(IV), free Cr(III), complexed Cr(III), and particulate metal. First, the sample is filtered through a 0.45-micron filler; filters are treated with diluted nitric acid to dissolve and determine the particulate chromium. The filtrate is used for three determinations: one of them on the acidified sample, without any treatment; another one after a coprecipitation with lead phosphate at pH 6-7 (both valency states are scavenged); and finally, the other one after a coprecipitation with lead sulfate at pH 3 (only Cr(VI) is collected). Graphite furnance (GF) AAS was used in all measurements using standards of K2Cr2O7 in 0.1 N HNO3. The responses of both valency states did not show significant statistical differences using coated as well as ordinary tubes. This scheme shows some important advantages: the concentration of Cr(VI), the species whose determination has more interest, is calculated directly, not by difference; in both coprecipitations the carriers do not interfere in the later measurement by GFAAS; the same standard solutions are used in the four necessary determinations for each sample, and it is not necessary to apply the standard additions method because the cation has been already scavenged from the original matrix; finally, the analytical procedure is relatively simple in comparison with the usual tedious laboratory work that is required by this kind of study. Results are presented from the use of the coprecipitation-AAS technique on samples from the San Reservoir. (Author's abstract)
W88-10525

COMPARISON OF DIGESTION METHODS FOR TRACE METAL DETERMINATION IN FISH.
Ibadan Univ. (Nigeria). Dept. of Chemistry.
S. E. Kakulu, O. Osibanjo, and S. O. Ajayi.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 3, July 1987. 1 fig, 3 tab, 14 ref.

Descriptors: *Heavy metals, *Pollutant identification, *Chemical analysis, *Trace metals, *Foods, *Fish, *Shellfish, Atomic absorption spectrometry, Standards, Comparison studies, Deltas, Niger Delta, Atlantic Ocean, Nigeria, Copper, Zinc, Lead, Nickel, Manganese, Iron, Tissue analysis, Water pollution.

The analytical comparison of some digestion methods used for trace metals (Cu, Zn, Pb, Ni, Mn, Fe) determination in fish by flame atomic absorption spectrophotometry (AAS) was studied. The results were also compared with those obtained for metals analysis by inductively coupled argon plasma-atomic emission spectrometric technique (ICP-AES). Both techniques showed good correlation. The average metal levels found in the fishes and shellfishes analyzed from the study area (Niger Delta area, Nigeria) by AAS technique were much lower than the World Health Organization's acceptable limits for metals in foods. (Author's abstract)
W88-10526

CALCUTTA POLLUTANTS: PART 1. APPRAISAL OF SOME HEAVY METALS IN CALCUTTA CITY SEWAGE AND SLUDGE IN USE FOR FISHERIES AND AGRICULTURE,
Jadavpur Univ., Calcutta (India). Dept. of Chemistry.
D. Chakraborrti, D. Ghosh, and S. Niyogi.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 4, p 243-253, 1987. 4 tab, 19 ref.

Descriptors: *Wastewater analysis, *Sludge disposal, *Pollutants, *Pollutant identification, *Chemical analysis, Wastewater, *Sludge, *Heavy metals, Chelate extraction, Atomic absorption spectrometry, India, Agriculture, Fish farming, Lead, Copper, Zinc, Cadmium, Chromium, Nickel, Cobalt, Manganese, Iron, Chromium, Land disposal.

A major concern with the practice of applying sewage-sludge to land is the heavy metal content of the sewage-sludge. A chelate extraction procedure followed by atomic absorption spectrometry (AAS) and inductively coupled plasma atomic emission spectrometry (ICP-AES) is described for the determination of some heavy metals (Pb, Cu, Zn, Cd, Ni, Co, Mn, Fe and Cr) in sewage and sludge. The procedure is applied to the determination of Calcutta sewage and sludge. The concentration of the above-mentioned heavy metals in Calcutta sewage-sludge is less than that of some cities in other countries. (Author's abstract)
W88-10527

SAMPLE HANDLING AND ANALYSIS FOR 51 VOLATILE ORGANICS BY AN ADAPTED PURGE AND TRAP GC-MS TECHNIQUE,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. Otson, and C. Chan.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 4, p 275-287, 1987. 1 fig, 3 tab, 15 ref.

Descriptors: *Pollutant identification, *Chemical analysis, Volatile organic compounds, Gas chromatography-mass spectrometry, Water pollution, Volatility, Aromatic compounds, Chlorinated hydrocarbons, Priority pollutants, Temperature effects, Surveys, Performance evaluation.

An adapted, purge and trap GC-MS (gas chromatography-mass spectrometry) technique using heated, 100 ml aqueous samples was evaluated for the determination of organics in a water quality survey. The 51 volatile organics consisted of 7 aromatic, 40 halogenated aliphatic and aromatic, and 4 other compounds and included the purgeable priority pollutants listed by the U.S. E.P.A. (Environmental Protection Agency) Detection limits <1 microgram/l, analytical precision $<15\%$ RSD (relative standard deviation), recoveries $>70\%$, and precision $<20\%$ RSD for recoveries over all three concentrations were generally obtained for the 51 standards, each spiked at 1, 10, and 50 micrograms/l into purified water. The few instances of abnormal recoveries, poor detection limits, and poor analytical precision were often related. Improved detection limits were obtained for several water-soluble and a few halogenated compounds when the concentrator trap composition was changed, transfer line temperature was decreased, and the sparger vessel temperature was increased. For survey control samples, i.e., spiked purified in bottles transported and stored up to 1 month, recoveries were 90 plus or minus 15% of those obtained for fresh calibration samples and the analytical precision for replicate control samples was $<20\%$ RSD for most of the organics. The importance of control samples in surveys was emphasized by the occurrence of some anomalous results. (See also W88-10530) (Author's abstract)
W88-10528

APPLICATION OF A PORTABLE ION CHROMATOGRAPH FOR FIELD SITE MEASUREMENTS OF THE IONIC COMPOSITION OF FOG WATER AND ATMOSPHERIC AEROSOLS,
Technische Univ., Vienna (Austria). Inst. fuer Analytische Chemie.
R. Tsitouridou, and H. Puxbaum.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 1, p 11-22, No-

vember 1987. 4 fig, 3 tab, 10 ref.

Descriptors: *Acid rain analysis, *Air pollution, *Aerosols, *Pollutant identification, *Chemical analysis, Fog, Acidity, Chromatography, Field tests, Cations, Po Valley, Italy, Chlorides, Nitrites, Nitrates, Sulfates, Organic compounds, Cations, Fluorides, Chemical interference.

For the analysis of selected organic and inorganic ions in atmospheric aerosol samples, single column ion chromatography was used. Atmospheric aerosol constituents were sampled with five-stage impactors, diffusion denuder trains and fog samplers. the concentrations of the components Cl(-), NO2(-), NO3(-), SO4(2-) and hydroxymethylsulfonate (HMSA) were determined by anion chromatography. Fluoride, formate, acetate, glycolate/lactate, propionate and butyrate were analyzed with ion exclusion chromatography, whereas monovalent cations Na(+), NH4(+) and K(+) with cation chromatography. Resolution of HMSA-formate and HMSA-chloride pairs which were the most problematic cases, were studied. Cross interferences and detections limits of all the ions of interest were determined. The methods were applied in a field sampling campaign in the Po Valley (Italy). (Author's abstract)
W88-10529

DETERMINATION OF TRACE LEVELS OF POLYOXYETHYLENE-TYPE NONIONIC SURFACTANTS IN ENVIRONMENTAL WATERS,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
K. Inaba.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 1, p 63-73, November 1987. 3 fig, 3 tab, 12 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Nonionic surfactants, *Detergents, Purification, Polyoxyethylene, Toluene, Solvent extraction, Water pollution, Chemical interference, Spectrophotometry.

An analytical method for polyoxyethylene-type nonionic surfactants is proposed. The surfactants are preconcentrated by solvent extraction with toluene and many coexisting substances such as LAS (linear alkylbenzene sulfonates) or humic acid are washed out at the same time. Those in the toluene can extract cobalt(II) from aqueous thiocyanate solution. By determination of the metal with spectrophotometry as 4-(2-pyridylazo-)-resorcinolato complex, the concentration of the surfactants can be measured. Use of toluene as the solvent is useful not only for the purification of the surfactants from many interferences but also for the easier treatment of waste solvents in comparison to, i.e., halogenated organic solvents. (Author's abstract)
W88-10531

DETERMINATION OF ORGANIC GROUP PARAMETERS: (AOCL, AOBR, AOS) IN WATER BY MEANS OF ION-CHROMATOGRAPHIC DETECTIONS, PYROHYDROLYSIS AND ABSORPTION,
Gesamthochschule Paderborn (Germany, F.R.). Dept. of Applied Chemistry.
G. Brandt, and A. Kettrup.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 129-143, November 1987. 8 fig, 2 tab, 25 ref.

Descriptors: *Water pollution, *Pollutant identification, *Chemical analysis, *Organic compounds, *Chromatography, Adsorbable organic halogen compounds, Adsorbable organic sulfur compounds, Ions, Pyrohydrolysis.

In recent years methods have been developed to determine organic halogen at the microgram/l level in water samples by adsorbing these compounds on active carbon and by detecting the inorganic halides formed after conversion of the adsorbates by pyrohydrolysis. By applying these techniques the analysis of the so-called 'Adsorbable Organic Halogen (AOX)' is performed. The distinction of each of the halogens in the group parameter AOX and the determination of the parameter 'adsorbable organic sulfur compounds (AOS)' can be realized using ion-chromatography for the detection of the anions, obtained after pyrohydrolysis of the adsorbed organic compounds. Further investigation have shown good adsorption capacity of a newly developed nearly chlorine- and sulfur-free active carbon for organic model substances. The examinations concerning the pyrohydrolysis of the organic solutes and adsorption of the formed inorganic species are presented. The conditions for complete conversion of the model substances and high recovery rates in inorganic anions have been proved successfully. The optimization of the pyrohydrolysis apparatus and of the combustion conditions have been performed and proved with good results. (Author's abstract)
W88-10533

NOVEL IN SITU CASCADE ULTRAFILTRATION UNIT SPECIFICALLY DESIGNED FOR FIELD STUDIES OF ANOXIC WATERS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
For primary bibliographic entry see Field 7B.
W88-10534

ANALYSIS OF ORGANIC MATTER IN WATER OF LOW TOC (TOTAL ORGANIC CARBON) CONTENT BY CHROMATOGRAPHIC TECHNIQUES,
Ecole Superieure de Physique et de Chimie Industrielles, Paris (France). Lab. de Chimie Analytique.
P. Subra, M. C. Hennion, A. Foucault, and R. Rosset.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 197-217, November 1987. 8 fig, 1 tab, 31 ref.

Descriptors: *Water analysis, *Pollutant identification, *Chemical analysis, *Organic matter, *Chromatography, *Drinking water, Water pollution, Liquid chromatography, Gas chromatography, Mass spectorscopy, Humic acids.

The problems encountered when analyzing organic pollutants in drinking water stem from the large number of unknown compounds at very low concentrations. The concentrations of the organics was carried out on n-alkyl silica after a rigorous cleaning or by liquid-liquid extraction. The complexity of these extracts renders a direct analysis by gas chromatography coupled with mass spectrometry impossible; hence, a pre-separation step is required. Reversed and normal phase chromatography have been investigated with these extracts. The former leads to informative fingerprints but subsequent identification is difficult. Normal phase liquid chromatography is more suitable and a separation by chemical classes of increasing polarity is applied to water extracts. The eluent is fractionated, each fraction is then gently evaporated and subsequently analyzed by GC (gas chromatography). Identification is then possible by coupling with mass spectrometry. These procedures are used to follow the changes in organic matter during the two last steps of the drinking water treatment: ozonization and filtration on active charcoal. Another application is the analysis of humic extracts. (Author's abstract)
W88-10535

BIOACCUMULATIVE BEHAVIOUR OF SOME PCB CONGENERS IN LAKE GENEVA BROWN TROUT (SALMO LACUSTRIS L.),
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. du Genie de l'Environment.
For primary bibliographic entry see Field 5B.
W88-10536

DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN INDIGENOUS AND TRANSPLANTED MUSSELS (MYTILUS EDULIS L.) ALONG THE DUTCH COAST,
Hoofdgroep Maatschappelijke Technologie TNO, Apeldoorn (Netherlands).
M. M. Boom.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 251-261, November 1987. 5 fig, 12 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Hydrocarbons, *Bioaccumulation, *Mussels, Chromatography, Coastal waters, Water pollution, The Netherlands, Water pollution sources, Monitoring, Bioindicators.

A method, originally developed to investigate the pollution of Dutch coastal water metals and PCBs (polychlorinated biphenyls), was modified for the determination of the pollution with polycyclic aromatic hydrocarbons (PAH). The method is based on active monitoring with mussels (Mytilus edulis L.). Its usefulness has already been demonstrated. A method for the determination of PAH in mussels has been developed. The method is based on the hydrolysis of tissue with 4 M sodium hydroxide, extraction with hexane, clean-up with 10% deactivated aluminum oxide and quantitative determination with reversed phase high performance liquid chromatography (RP-HPLC) and fluorescence detection. The accumulation plateau of most of the PAH studied has not been reached after 60 days. Gradients of pollution were found, and at least one significant source near Urmviden was detected. (Author's abstract)
W88-10537

FLOW INJECTION ANALYSIS OF HYDROGEN PEROXIDE, SULFITE, FORMALDEHYDE AND HYDROXYMETHANESULFONIC ACID IN PRECIPITATION SAMPLES,
Netherlands Energy Research Foundation ECN, Petten.
M. P. Keuken, F. P. Bakker, W. A. Lingerak, and J. Slanina.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 263-279, November 1987. 6 fig, 3 tab, 23 ref.

Descriptors: *Acid rain, *Air pollution, *Flow injection, *Chemical analysis, *Fog, *Precipitation, *Dew, *Acidity, Hydroxymethanesulfonic acid, Chromatography, Sulfates, Sulfites, Hydrogen peroxide, Formaldehyde.

Hydroxymethanesulfonic acid (HMSA), the reaction product of sulfite and formaldehyde, plays an important part in the aqueous phase conversion of sulfite to sulfate. HMSA is fairly stable under acidic conditions and in the presence of hydrogen peroxide. Sulfite is unstable under these conditions. A flow injection set-up was developed, that allows the determination of H2O2, sulfite, formaldehyde and hydroxymethanesulfonic acid. H2O2 analysis by amperometric detection offers the possibility of a simple, robust field instrument. The detection limit of these compounds is 50 micrograms/l and the method is linear up to 5 mg/l. A large fraction of S(IV) is present as HMSA in fog, dew and precipitation samples in The Netherlands. (Author's abstract)
W88-10538

QUALITY ASSURANCE STUDY FOR THE ANALYSIS OF HYDROCARBONS IN SEDIMENTS,
Instituto de Quimica Bio-Organica, Barcelona (Spain). Dept. of Environmental Chemistry.
J. Albaiges, and J. Grimalt.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 281-293, November 1987. 2 fig, 3 tab, 12 ref.

Descriptors: *Petroleum hydrocarbons, *Oil pollution, *Marine sediments, *Chemical analysis, *Chromatography, *Quality control, Errors, Statistics, Aromatic compounds.

Two exercises (MEDCAL I and II) were conducted during November 1984 and October 1986, with participants from the Mediterranean region, for testing the IOC (International Oceanographic Commission) Manual for the determination of petroleum hydrocarbons in sediments (IOC, Manuals and Guides, No. 11). The gas chromatographic analysis of the saturated hydrocarbon fraction provided, at the best, a precision of 60% (relative standard deviation, RSD) for n-alkanes (mean concentration 0.89 micrograms/g) and 56% for the unresolved complex mixture (UCM) (mean con-

centration 16 micrograms/g). The CPI (n-alkane odd-even predominance) and the pristane/phytane ratio provided better results (13% RSD). The aromatic fractions, analyzed by UV-fluorescence, yielded in total a mean concentration of 10 micrograms/g of chry-ene equivalents with a 49% RSD. The extraction-partition step was confirmed to be the main source of error in the analysis because when the results were corrected for recoveries, the RSD were reduced to 17, 30 and 6% for n-alkanes, UCM and total aromatics, respectively. The reference inter-laboratory precision was, respectively, 18, 14, and 14%. (Author's abstract)
W88-10539

LIQUID CHROMATOGRAPHIC DETERMINATION OF CATIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES USING A CONTINUOUS POST-COLUMN ION-PAIR EXTRACTION DETECTOR WITH A SANDWICH PHASE SEPARATOR,
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
C. De Ruiter, J. C. H. F. Hefkens, U. A. T. Brinkman, R. W. Frei, and M. Evers.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 325-339, November 1987. 6 fig, 3 tab, 19 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Surfactants, *Liquid chromatography, Cationic surfactants, Ditallowdimethylammonium chloride, Statistics, Rivers, Water pollution.

A new detection technique is described for the quantitative analysis of cationic surfactants by HPLC (high performance liquid chromatography) via post-column ion-pair formation. A new sandwich type phase separator, as part of the extraction detector, was successfully introduced. The method was used to determine ditallowdimethylammonium chloride (DTDMAC) in various environmental samples. Detection limits of DTDMAC in river water were about 2 micrograms/l (60 ng absolute; S/N=5) and ng/l (260 pg absolute; S/N=5), using methyl orange and 9,10-dimethoxyanthracene-2-sulfonate (DAC) as ion-pairing agents, respectively. The environmental concentration of DTDMAC found on random samples from 2 Belgian rivers range from 30 to 40 micrograms/l. The reproducibility of the determination of DTDMAC in river water was 4.2% (RSD; relative standard deviation) (n=20). (Author's abstract)
W88-10540

ANALYSIS OF DISPERSE YELLOW 42 IN ENVIRONMENTAL SAMPLES.
Bayreuth Univ. (Germany, F R.). Chair of Ecological Chemistry and Geochemistry.
V. Breitung, B. Packebusch, and O. Hutzinger.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 32, No. 2, p 135-144, January 1988. 3 fig, 3 tab, 13 ref.

Descriptors: *Chemical analysis, *Chromatography, *Dyes, *Dye industry wastes, Disperse Yellow 42, Gas chromatography, Mass spectrometry, Natural waters, Liquid chromatography, Adsorption chromatography, Sediments.

An analytical procedure was developed for determining low concentrations of Disperse Yellow 42 in natural water and sediment samples. The dye is extracted with organic solvents, cleaned up by adsorption chromatography, concentrated, and analyzed by reversed phase HPLC (high-performance liquid chromatography). A method to identify DY 42 in samples with GC/MS (gas chromatography/mass spectrometry) is also described. (Author's abstract)
W88-10542

METHODS OF BACKGROUND ENVIRONMENTAL POLLUTION MONITORING APPLIED IN CMEA MEMBER COUNTRIES,
Akademiya Nauk SSSR, Moscow. Natural Environment and Climate Monitoring Lab.
F. Y. Rovinsky, M. I. Afanasyev, L. V. Burtseva, and E. I. Yushkan.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 32, No. 3-4, p 167-176, February 1988. 11 ref.

Descriptors: *Water pollution control, *Monitoring, *Quality control, *Pollutant identification, *Chemical analysis, Pesticides, Ozone, Heavy metals, Hydrocarbons, Chlorinated hydrocarbons, Eastern Europe.

Methods of environmental sampling and procedures are described for determination of sulfur dioxide, sulfate, ozone, nitrogen oxides, mercury, lead, cadmium, arsenic, DDT and other organochlorine pesticides such as 3,4-benzo(a)pyrene and other PAHs (polycyclic aromatic hydrocarbons) at background levels in environmental media used at background stations (Bulgaria, Hungary, East Germany, Poland, Romania, Czechoslovakia, Soviet Union. The program and methodology of the quality assurance of the information on pollutants' content in environmental media received when different procedures and devices are applied, are envisaged. (Author's abstract)
W88-10544

CLUSTER ANALYSIS AS A TOOL IN THE STUDY OF GROUNDWATER QUALITY,
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
G. Rauret, R. Rubio, F. X. Rius, and M. S. Larrechi.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 32, No. 3-4, p 255-268, February 1988. 8 fig, 3 tab, 14 ref.

Descriptors: *Chemical analysis, *Pattern recognition, *Groundwater pollution, *Water sampling, Aquifers, Cluster analysis, Spain, Alkalinity, Sulfates, Hydrogen ion concentration, Conductivity, Aquifers, Aquifer characteristics.

A study of the vulnerability of the river Tenes aquifer has been carried out by means of cluster analysis. On the basis of 11 features measured for 47 groundwater samples, pattern recognition techniques allow the visualization of several types of waters. Moreover, the natural differences occurring between manual and pump sampling procedures have arisen. Alkalinity and pH and to a lesser extent sulfates and conductivity have been identified as the features which contribute to the differentiation of the water samples according to the sampling procedure. The withdrawal from the chemometric analysis of these variables leads to the presence of a sole type of water quality in which those samples that show the influence of the surface pollution can be distinguished. (Author's abstract)
W88-10546

DETERMINATION OF NITRITE BY REVERSE FLOW INJECTION ANALYSIS,
Murcia Univ. (Spain). Dept. of Analytical Chemistry.
P. Vinas, M. Hernandez Cordoba, and C. Sanchez-Pedreno.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 32, No. 3-4, p 279-289, February 1988. 6 fig, 1 tab, 38 ref.

Descriptors: *Spectrophotometry, *Nitrites, *Meat processing industry, *Pollutant identification, Cured meats, Reverse flow injection analysis, Wastewater pollution, Curing, Dyes, Safranin-T.

A simple method for the determination of nitrite using flow injection analysis is proposed. Safranine-T is quickly diazotized by nitrite and coupled with an excess of this dye. The rFIA (reverse flow injection analysis) mode with a single-channel gives maximum sensitivity. The influence of reaction variables and rFIA manifold, the precision and accuracy of the method and the effects of foreign ions are studied. The procedure is applied to the determination of nitrite in wastewaters and cured meats. (Author's abstract)
W88-10548

NIOBIUM IN THE ENVIRONMENT AND A NEW METHOD FOR ITS TRACE ANALYSIS USING MOLECULAR OR ATOMIC ABSORPTION SPECTROMETRY,
Centre for Water Resources Development and Management, Calicut (India). Water Quality and Environment Div.
For primary bibliographic entry see Field 7B.
W88-10550

EFFECT OF INDUSTRIAL POLLUTION ON LAKE EWINGI (MASURIAN LAKELAND) ESTIMATED BY REMOTE SENSING TECHNIQUES,
Instytut Ksztaltowania Srodowiska, Warsaw (Poland).
M. Giercuszkiewicz-Bajtlik.
Ekologia Polska ELPLBS, Vol. 34, No. 2, p 193-201, 1986. 2 fig, 4 tab, 9 ref.

Descriptors: *Lake Ewingi, *Maps, *Water pollution, *Lakes, *Industrial wastes, *Remote sensing, *Poland, Aerial photography, Pollution index, Spatial distribution.

Aerial multispectral photographs of Lake Ewingi were taken in August 1979 to elaborate a map of surface distribution of pollution concentrations of lake water. This map provided information on the quantitative and qualitative pollution of the entire aquatic environment at the moment of investigations and on main sources of lake pollution. The sensitivity of the method for particular water pollution indices was determined. (Author's abstract)
W88-10611

ACCUMULATION OF ORGANOCHLORINES AND MERCURY IN FLOUNDER - AN APPROACH TO POLLUTION ASSESSMENTS,
Biologische Anstalt Helgoland (Germany, F.R.)
A. Kohler, U. Harms, and B. Luckas.
Helgolaender Meeresuntersuchungen HEMEDC, Vol. 40, No. 4, p 431-440, 1986. 4 fig, 1 tab, 29 ref.

Descriptors: *Bioindicators, *Polychlorinated biphenyls, *Chlorinated hydrocarbons, *Mercury, *Pollutant identification, *Water pollution effects, *Population exposure, *Flounders, *Bioaccumulation, Toxicity, Estuaries, Industrial pollutants, Seasonal variations, Fish populations, Marine sediments, Oxygen depletion, Animal tissues.

Levels of polychlorinated biphenyls (PCBs) Hexachlorobenzine (HCB) and Hg were determined in the muscle tissue of flounder (Platichthys flesus L.), sampled at two sites of the highly industrialized Elbe estuary that is characterized by a decreasing gradient of contaminant levels in water and sediments toward the mouth of the river. The contaminant levels were compared to those found in muscle tissue of flounders caught in an unpolluted reference area, the Eider estuary. Juvenile flounders (1-2 cm total length) caught during their migration from the southern North Sea coast into the Elbe estuary in early summer showed a significantly higher level of contamination at both Elbe stations than those from the reference area. In the following spring, the flounders, having grown to a length of 12-14 cm, reflected the gradient of contaminants measured in water and sediment. However, during summer and late autumn, a drastic increase in average contaminant concentration was observed in the muscle tissue of flounders taken from the less polluted estuarine site. It became evident that severe oxygen depletion in the heavily polluted area near Hamburg had provoked the migration of highly contaminated fish downstream to the less polluted sampling area; thus intermingling with the less contaminated flounder population of this region had occurred. The results obtained indicate that careful analysis of environmentally controlled behavioral patterns in the species used for monitoring purposes as well as an appropriate statistical treatment of the data gained from chemical analysis are essential for assessing the contaminant concentrations in organisms in relation to the pollution load of their habitats. (Author's abstract)
W88-10631

DETERMINING PATHOGEN LEVELS IN SLUDGE PRODUCTS,
N. Goldstein, W. A . Yanko, J. M. Walker, and W. Jakubowski.
Biocycle BCYCDK, Vol. 29, No. 5, p 44-47, 67, May/June 1988. 3 tab.

Descriptors: *Sludge utilization, *Compost, *Pollutants, *Sludge solids, *Pathogens, *Pollutant identification, Microorganisms, Laboratories, Chemical analysis, Sewage, Public health, Population exposure, Risks.

The San Jose Creek Water Quality Laboratory (part of the Los Angeles County Sanitation Districts) in Whittier, California, conducted a study of pathogens in sludge products that could be distributed and marketed to the general public. This study was conducted under contract with the U.S. EPA's Health Effects Research Laboratory in Cincinnati, Ohio. This article recounts that study, whose basic objective was to determine the types and concentrations of various non-pathogenic indicator microorganisms and pathogenic microorganisms that may be present in these sludges. The findings were published in a report called: 'Occurrence of Pathogens in Distribution and Marketing Municipal Sludges.' The study also surveyed the presence of chemicals in distributed and marketed sludges. Composts and other sludge products were sampled in a total of 26 facilities. Samples were analyzed for a variety of bacteria, viruses, parasites and fungi. The only potential pathogens that were detected were bacterial, including Salmonella, Yersinia, and toxigenic Escherichia coli. No health hazard was found associated with respect to parasitic helminth ova, Campylobacter (a bacterium that can cause gastroenteritis, or enteric viruses). All of the sewage sludge products examined were found to contain variable concentrations of non-pathogenic indicator microorganisms. The report stated that the extent of risk associated with the use of sludge products has not been determined. Researchers found no reports of anyone contracting an illness from using a sludge compost-based fertilizer or soil amendment product. (Friedmann-PTT)
W88-10637

BACTERIOPHAGES AS MODEL ORGANISMS IN WATER TREATMENT,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
For primary bibliographic entry see Field 5F.
W88-10744

DETERMINATION OF THE ORTHOPHOSPHATE AND TOTAL ORTHOPHOSPHATE, SENSITIVITY AND REPRODUCIBILITY,
Institut Hygieny a Epidemiologie, Prague (Czechoslovakia).
J. Popovsky.
Limnologica LMNOA8, Vol. 17, No. 2, p 255-258, October 1986. 2 tab, 5 ref.

Descriptors: *Orthophosphates, *Chemical analysis, *Qualitative analysis, Sensitivity, Testing procedures, Water analysis.

Four methods of orthophosphate analysis are compared. Limit of sensitivity, reproducibility, interferences, contamination during the procedure, storage of samples, and the advantages and disadvantages of each method are discussed. The most important interferences seem to be caused acid by compounds of arsenic, which react in the same way as the orthophosphates. The most frequent analytical method for orthophosphates is the reaction of ammonium molybdate in sulfuric acid and a reduction of the hexadimolybdenphosphoric acid. Methods using organic solvents for the extraction of the phosphomolybdenum complex and reduction with ascorbic acid or stannous chloride are useful for removing many of the interferences and increasing the reproducibility and sensitivity of the procedure. The most commonly used method for the determination of total orthophosphates is complete hydrolysis using sulfuric acid and hydrogen peroxide or perchloric acide. Tabulation of the four methods includes limit of determination, reproducibility, interferences, chemicals used, and advantages and disadvantages. (Friedmann-PTT)
W88-10811

GAS CHROMATOGRAPHIC/MASS SPECTROMETRIC IDENTIFICATION OF CHLORINATED AND OXYGENATED CYCLOHEXENE ARTIFACTS FORMED DURING THE ANALYSIS OF CHLORINATED WATER SAMPLES,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
A. M. Dietrich, R. F. Christman, and G. S. Durell.
Biomedical and Environmental Mass Spectrometry BMSYAL, Vol. 5, No. 8, p 453-458, April 1988. 4 fig, 1 tab, 19 ref.

Descriptors: *Pollutant identification, *Mass spectrometry, *Contamination, *Gas chromatography, *Spectrometers, *Water analyis, Drinking water, Organic compounds, Quantitative analyis, Chemical properties, Chemical reactions, Chlorination.

Chlorinated and oxygenated cyclohexene derivatives detected in methylene chloride extracts of chlorinated drinking water were demonstrated to be artifacts produced during sample preparation. Commercial methylene chloride contains cyclohexene as a preservative, and this reacted during the extraction/concentration process to produce microgram amounts of chlorocyclohexene, 2-chorocyclohexanol, trans-1,2-dichorocyclohexane, cyclohexenone and cyclohexenol. Quantitative analysis indicated that over 90% of the initial cyclohexene was consumed during the process. Dechlorination of drinking water with sodium arsenite significantly reduced but did not eliminate cyclohexene artifact formation. (Author's abstract)
W88-10838

EVALUATION OF A HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY METHOD FOR THE DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN SOIL AND WATER,
Midwest Research Inst., Kansas City, MO.
J. S. Stanley, T. M. Sack, Y. Tondeur, and W. F. Beckert.
Biomedical and Environmental Mass Spectrometry BMSYAL, Vol. 17, No. 1, p 27-35, July 1988. 2 fig, 4 tab, 19 ref.

Descriptors: *Pollutant identification, *Mass spectrometry, *Gas chromatography, *Dioxin, Spectrometers, Soil contamination, Water pollution, Organic compounds, Chemical analysis, Water analysis, Soil analysis, Chemical properties.

An analytical protocol for the determination of 2,3,7,8-tetrachlorodibenzo-p-dioxion (2,3,7,8-TCDD) and total TCDSs in soil, sediment, and aqueous samples using high-resolution gas chromatography/high-resolution mass spectrometry (HRGC/HRMS) was evaluated through replicate analyses of fortified and unspiked soil and aqueous samples. The results of these analyses demonstrated that the method is useful for the determination of 2,3,7,8-TCDD and total TCDDs at concentrations ranging from 10 to 200 pg/g (ppt) in soil samples and from 100 to 2000 pg/l (ppq) in aqueous samples. Absolute recoveries of the method internal standard, (13C12-2,3,7,8-TCDD), ranged from 24-88%. Lower levels of detection can be achieved through a slight modification of the method with respect to initial sample size and/or final extract volume. Instrumental parameters that affect data quality, specifically HRGC column performance, mass resolution and mass measurement accuracy are presented. (Author's abstract)
W88-10839

SCYTOSIPHON LOMENTARIA (PHAEOPHYTA) AS AN INDICATOR OF HEAVY-METAL CONTAMINATION OF SEA WATERS,
Akademiya Nauk SSSR, Vladivostok. Inst. of Pacific Ocean Geography.
N. K. Khristoforova.
PSZNI: Marine Ecology, Vol. 6, No. 2, p 121-126, 1985. 1 tab, 21 ref.

Descriptors: *Heavy metals, *Bioindicators, *Pollutant identification, *Water pollution, *Algae, Lead, Iron, Coastal waters, Marine environments, Sea of Japan, Monitoring, Mollusks, Plant morphology.

The brown alga Scytosiphon lomentaria is discusses as a possible indicator of heavy-metal contamination of marine coastal waters. A comparison with other brown algae shows that a strong development of the specific surface of S. lomentaira thallus increases the ability of accumulating suspended iron and lead from ambient waters. The paper presents the results obtained from several localities in the Sea of Japan. Scytosiphon is shown to have an advantage over other indicator species used in the monitoring of sea heavy-metal contamination due to its virtually 'cosmopolitic' distribution. It is suggested that algae may be superior to molluscs for monitoring pollution. Morphological and metabolic simplicity, absence of sex differences, and no need for time-consuming depuration are among the advantgages of algae. (Author's abstract)
W88-10852

EFFECT OF COPPER, CADMIUM AND ZINC ON FISH-FOOD ORGANISMS, DAPHNIA LUMHOLTZI AND CYPRIS SUBGLOBOSA,
Andhra Pradesh Agricultural Univ., Hyderabad (India). Dept. of Fishery Science.
For primary bibliographic entry see Field 5C.
W88-10861

PROFUNDAL MACROBENTHOS IN A POLLUTED LAKE: DEPTH DISTRIBUTION AND ITS RELATIONSHIP WITH BIOLOGICAL INDICES FOR WATER QUALITY ASSESSMENT,
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
For primary bibliographic entry see Field 5C.
W88-10888

EXAMINATION OF SURFACE WATERS USED A SOURCES OF SUPPLY IN THE PORT HARCOURT AREA: II. CHEMICAL HYDROLOGY,
Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria). Microbiology Div.
For primary bibliographic entry see Field 5F.
W88-10891

COMPARATIVE STUDY ON THE PRECONCENTRATION OF COPPER TRACES IN NONSALINE WATERS WITH CHELATING RESINS,
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
D. Vousta, C. Samara, K. Fytianos, and T. Kouimtzis.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 330, No. 7, p 596-599, May 1988. 1 fig, 3 tab, 16 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chemical analysis, *Copper, *Chelating agents, *Resins, Trace metals, Chelex 100, Hyphan cellulose, Amberlite IRC 718, Rivers, Lakes, Comparative studies.

Chelex 100, Hyphan cellulose and Amberlite IRC 718 were tested with regard to their chelation efficiency for copper traces. The retention of copper on the three resins was quantitative above pH 3. Complete elution, however, from Chelex 100 and Hyphan was only possible by a mixture of HNO3 and HCl. These two resins were compared relevant to their preconcentration efficiency for copper traces from river and lake water samples. When employing the batch equilibration technique, sufficient recoveries were achieved for both of them. The presence of complexing agents such as EDTA, NTA, sodium polyphosphate and humic acids affected the preconcentration efficiency of Chelex 100 as well as that of Hyphan. Chelex 100 seemed to be more free from EDTA and NTA interferences than the Hyphan exchanger. (Author's abstract)
W88-10901

DETERMINATION OF SELENIUM IN SEDIMENTS BY HYDRIDE GENERATION ATOMIC ABSORPTION SPECTROMETRY: ELIMINATION OF INTERFERENCES,
Nagoya City Environmental Pollution Research Inst. (Japan).
K. Itoh, M. Chikuma, and H. Tanaka.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 330, No. 7, p 600-604, May 1988. 6 fig, 3 tab, 18 ref.

Descriptors: *Selenium, *Chemical analysis, *Pollutant identification, *Trace metals, *Heavy metals, Estuaries, Sediments, Atomic absorption spectroscopy, Fluorometry.

The hydride generation/atomic absorption spectrometry (AAS) with an automated flow system is useful for the routine analysis of selenium in environmental samples. This method is, however, subject to interferences from transition metal ions and other hydride forming ions. The conditions to minimize the interferences were established: the concentration of HCl 6 mol/l; the concentration of tetrahydroborate 0.5%. Iron(III) chloride released the depression of selenium signals by metal ions such as copper(II) and bismuth(III). Selenium in several standard reference materials including sediment samples was determined by the present method and by fluorimetry with 2,3-diaminonaphthalene (DAN). The results obtained by the 2 methods agreed with an acceptable precision. This means that hydride generation/AAS offers good precision and accuracy in the determination of selenium in sediment samples as well as DAN fluorimetry. However, the former is much simpler in operation. The method was applied to the determination of selenium in estuarine sediments collected in Nagoya harbor and Ise Bay. The results can be used to assess the pollution state of these places. (Author's abstract)
W88-10902

MULTISPECIES TESTS: RESEARCH NEEDS TO ASSESS THE EFFECTS OF CHEMICALS ON AQUATIC LIFE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W88-10999

HARMONIZATION OF BIOLOGICAL TESTING METHODOLOGY: A PERFORMANCE-BASED APPROACH,
Environmental Monitoring Systems Lab., Las Vegas, NV.
L. R. Williams.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 288-301, 2 fig, 1 tab, 4 ref.

Descriptors: *Toxicology, *Performance evaluation, *Water quality control, *Biological studies, *Testing procedures, *Monitoring, *Aquatic toxicology, Chemical analysis, Standards, Evaluation.

The latitude provided in many written biological test methods, including ASTM standard practices, is such that different laboratories can produce widely varying test results on the same test materials while in technical compliance with the 'method.' One obvious solution to this problem is to standardize upon more tightly controlled, less flexible testing procedures. This approach, while widely accepted in the field of chemistry, has been strongly resisted by the biological testing community. This paper presents an alternative approach to achieving comparability of testing data among laboratories while retaining a high degree of flexibility for the individual laboratory. The keys to this approach are: (1) the development and routine use of standard reference materials for test system calibration and control; (2) the development of 'reference standard methods' that are sufficiently controlled that responses of the test systems to known test materials are predictable and reproducible; and (3) participation in external performance evaluation programs. Recommendations for implementation of a performance-based method evaluation program are offered. (See also W88-10991) (Author's abstract)
W88-11013

USEFULNESS OF THE LIPID INDEX FOR BIOACCUMULATION STUDIES WITH DAPHNIA MAGNA,
Battelle Pacific Northwest Labs., Richland, WA.
D. D. Dauble, D. C. Klopfer, D. W. Carlile, and R. W. Hanf.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 350-358, 2 fig, 2 tab, 19 ref. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Toxicology, *Bioassay, *Lipid index, *Bioaccumulation, *Lipid index, Aquatic toxicology, *Daphnia, Aquatic animals, Water pollution effects, Toxicity, Biological magnification, Population dynamics, Carbon radioisotopes, Monitoring, Lipids.

Bioaccumulation studies with Daphnia magna have become an important tool for hazard evaluation of potentially toxic materials released to aquatic environments. Despite widespread use of this test organism, little attention has been paid to influence of stored lipids on uptake of xenobiotics. Principles of zooplankton population dynamics in the limnological literature were drawn upon to define experimental parameters for bioconcentration testing of organic compounds. Adult test populations were initially starved and monitored for lipid content and brood production. Mean lipid index values declined at 72 h to < 50% of those observed at 24 h. The number of hatched young peaked at 48 h and was inversely related to lipid storage and ovary production. In a separate experiment, uptake kinetics of 14-C-labelled quinoline were compared between two daphnid test groups with mean lipid scores of 5.4 and 2.8, respectively. Total radioactivity was significantly higher for the high lipid group at 8 h, and the coefficient of variation was lower. Estimated bioconcentration factors adjusted to dry weight were similar. These studies indicated that lipid reserves of daphnid test populations can be routinely monitored as an indicator of stress in the laboratory. Bioaccumulation tests should be limited to < 24 h to avoid depletion of lipid stores, which may cause increased variation in tissue concentration over time. (See also W88-10991) (Author's abstract)
W88-11019

EFFECT OF CONSTRUCTION, INSTALLATION, AND DEVELOPMENT ON THE TURBIDITY OF WATER IN MONITORING WELLS IN FINE-GRAINED GLACIAL TILL,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
D. G. Paul, C. D. Palmer, and D. S. Cherkauer.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 417-441, 10 fig, 2 tab, 10 ref. USGS Grant 14-08-0001-A0410.

Descriptors: *Monitoring, *Wells, *Drilling, *Groundwater, *Turbidity, *Wells, *Glacial soils, Wisconsin, Suspended solids, Well screens, Piezometers, Boreholes, Groundwater level, Water sampling, Construction materials, Water quality control.

Twenty monitoring wells were installed in fine-grained glacial till at two sites in southeastern Wisconsin to study the effects of monitoring-well construction, installation, and development on the amount of fine-grained suspended material in the well. The types of well screens used were continuous-slot, factory-slot, factory-slot with a filter wrap, and porous piezometer tips. Some of the wells were installed before the open borehole began to fill with water; others were installed after the water levels in the lower section of the borehole had begun to rise. About half of the wells were developed by surging while the others were simply bailed without surging. Installation of the wells in the initially-dry holes resulted in wells that yielded samples with very low turbidity compared with wells installed in wet holes. Water samples from wells that were surged were more turbid than those that were not. The type of construction materials investigated had no effect on the turbidity of samples from the wells. (See also W88-11031) (Author's abstract)
W88-11056

DEEP DEDICATED PUMP INSTALLATION FLORIDA EDB CONTAMINATION INVESTIGATION,
CH2M Hill, Tampa, FL.
J. C. Miller, and D. A. Fischer.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 27-37, 3 fig, 4 ref.

Descriptors: *Pesticides, *Ethylene dibromide, *Path of pollutants, *Water pollution sources, *Florida, Aquifers, Fumigants, Soil contamination, Well water, Potable water, Nematodes, Monitoring wells, Groundwater pollution, Pollutant identification.

To control burrowing nematodes, the soil fumigant ethylene dibromide (EDB) was applied to Florida soils for 20 years. EDB application, 25 gallons per acre, was by injection into the well-drained, sandy soils of citrus groves as buffer zones. In mid-1983, EDB was found in deep wells in Central Florida's citrus-growing region. Since EDB has possibly adverse human health effects, the Florida Department of Environmental Regulation funded an investigation to develop information concerning the magnitude of EDB contamination and to determine EDB behavior in Florida soils and groundwater. The investigation was divided into three tasks: (1) Site selection, (2) EDB mobility dynamics, and (3) EDB degradation. The process of site selection, deep monitor well installation, dedicated sampling pump installation/use, and analytical results are presented as early output from this investigation. Three quarters of groundwater sampling and analysis, beginning in October 1985, show that Floridan aquifer Monitor Well HC-1 at the Kuhlman site in Highlands County, Florida is free of EDB. Water table aquifer Monitor Well HC-2, located immediately adjacent to HC-1 and other water table monitor wells at the Kuhlman site contain up to 0.440 ppb EDB. (See also W88-11084) (Miller-PTT)
W88-11087

AUDITING EXISTING MONITOR WELLS,
Technos, Inc., Miami, FL.
M. S. Turner, and R. C. Benson.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 315-323, 1 tab, 10 ref.

Descriptors: *Monitoring wells, *Sampling, *Groundwater pollution, *Water quality, *Wells, Well logs, Planning, Inspection, Data acquistion.

Many old monitor wells, which provide the basis for long-term groundwater quality monitoring, have either poor or no geologic logs and installation records. Unusual water level or chemical results can cost considerable time and money. Existing monitor wells, which are cased with PVC or steel, can be audited to obtain hydrogeologic data and construction details, to assure that each well is providing high quality data. Data from existing wells can be obtained by using a downhole television camera to determine well-screen interval, evaluate whether the screen is plugged, and assess overall conditions within a well. Both water quality and hydrogeologic conditions outside PVC-cased wells can be determined by the use of an electromagnetic induction log. Nuclear logs can be run to characterize the geologic strata and assess construction details. The result of a monitor well

audit is a statement of well construction and condition, an assessment of hydrogeologic conditions, and an evaluation of potential contamination outside the well casing. The audit identifies any problems that may exist, what type of action is necessary to correct it, or if the well should be abandoned. (See also W88-11084) (Author's abstract)
W88-11106

MONITORING SURFACE SOIL GAS FOR DELINEATING GROUND WATER CONTAMINATION BY PETROLEUM,
Idaho Div. of Environment, Boise.
C. Brower.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 365-380. 9 fig, 2 tab.

Descriptors: *Pollutant identification, *Oil pollution, *Monitoring, *Soil gases, *Groundwater pollution, *Petroleum products, Subsurface mapping, *Plumes, Path of pollutants, Soil tests, Contamination.

In the case of volatile contaminants such as petroleum, analysis of vapors in the overlying soil can be used as a preliminary method of mapping subsurface contaminant plumes. A field study was conducted in an area of well defined petroleum contamination in Idaho to compare the data obtained by surface-emplaced soil vapor collectors and those data derived from an extensive ground water monitoring network. The collectors supplied by the PETREX Company proved to be capable of delineating the extent and relative severity of petroleum contamination as well as being sensitive to seasonal changes in depth of free product on the water table. The collectors used in this study were easily buried slightly below the soil surface and left in place for one to two weeks. As a reconnaissance technique for delineating surface contamination, these collectors offer several advantages. Because the vapor flux is integrated over time the collectors offer greater sensitivity and data are statistically more representative than instantaneous surface vapor measurements. They are far less expensive than monitoring wells and involve less surface disturbance. Because this technique provides no quantitative data on ground water contamination, it cannot substitute for actual ground water monitoring. However, as a tool for initial site investigation to identify potentially responsible parties and to aid in the subsequent siting of wells, soil gas sampling was found to be reliable and cost effective. (See also W88-11121) (Author's abstract)
W88-11140

RECENT ADVANCES IN THE DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN GROUND WATER,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
J. F. Pankow.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 501-504. 4 ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Organic compounds, *Groundwater pollution, *Chemical analysis, *Fused silica capillary column gas chromatography, *Laboratory equipment, Groundwater, Cryogenics, Silica.

Two new fused silica capillary column gas chromatography (GC) methods are now available for the determination of volatile organic compounds in water. The first method involves the interfacing of a conventional purge and trap (P and T) concentrator to fused silica capillary GC through the use of whole column cryotrapping (WCC). A trap-dry step helps to reduce the amount of water that is passed to the column, so plugging to the column with ice is not a problem even when large (440 ml) purge gas volumes are used. The P and T/WCC method is easy to use, and may be carried out with 100% of the P and T desorption flow passing to the analytical column. WCC temperatures in the range -90 to -30 C are used. Column film thicknesses of 1.0 microns give good results. The second method, also developed in our laboratory involves the direct purging of a 1-5 mL sample to a fused silica capillary column. In this case, a 0.53 mm i.d., DB-624 column is used. As they are being purged from the sample, the compounds are focused on the column with WCC. Temperatures of -90 to -80 C are effective in trapping all of the purgeable priority pollutants. After the purge setup, the GC run is started immediately. If purge gas volumes of the order of 100 mL are used, this 'purge and whole column cryotrapping' (P/WCC) method is not complicated greatly by the small amount of water that is purged along with the analytes. The major advantages of P/WCC are low cost, high reliability due to its great simplicity, low background contamination, minimal time required for each chromatogram, need to retain very volatile compounds on a P and T trap eliminated, and overall time for each analysis minimized. (See also W88-11121) (Author's abstract)
W88-11146

GROUND WATER INVESTIGATION AND DATA COMPILATION FOR GAS WORKS PARK, SEATTLE, WASHINGTON,
Tetra Tech, Inc., Bellevue, WA.
For primary bibliographic entry see Field 2F.
W88-11151

CERTIFICATION OF LOCAL LABORATORIES ANALYZING DRINKING WATER IN NONPRIMACY STATES,
Environmental Protection Agency, Denver, CO. Region VIII.
J. J. Hillman.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 103-109, 5 tab, 5 ref.

Descriptors: *Drinking water, *Quality control, *Certification, *Laboratories, Legal aspects, Water law, Chemical analysis, Radioactive tracers, Water quality control, Potable water, Water analysis, Microbiolological studies.

The U.S. Environmental Protection Agency (EPA) certification procedures for local laboratories analyzing drinking water for compliance with the Safe Drinking Water Act are discussed. A local laboratory is defined as a nonprincipal state laboratory and may include state, county, municipal, federal, or commercial laboratories. The EPA certification program has recently been updated and clarified in the 1983 edition of the EPA certification manual. Critical elements for certification in chemistry, microbiology, and radiochemistry have been revised and include the preparation of a quality assurance (QA) plan. Requirements to maintain certification as well as criteria and procedures for downgrading a laboratory's certification status are described in the manual. Technical services to be provided by EPA have been expanded. The certification program, changes that are incorporated in the new manual that will affect the certification of local laboratories, and potential future changes are briefly described. (See also W88-11158) (Author's abstract)
W88-11164

ANALYTICAL METHOD AND QUALITY CONTROL PROGRAM FOR STUDIES OF CURRENTLY USED PESTICIDES IN SURFACE WATERS,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
J. W. Kramer, and D. B. Baker.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 116-132, 4 fig, 7 tab, 8 ref.

Descriptors: *Herbicides, *Pesticides, *Quality control, *Water analysis, *Surface water, Organic pesticides, Hydrographs, Runoff, Chemical analysis, Laboratories, Quantitative analysis, Agricultural runoff, Gas chromatography.

Studies of the transport and loading of currently used pesticides in rivers draining large agricultural river basins pose numerous problems for the analytical laboratory. Most of the annual export occurs during the first two runoff events following the period of major pesticide application. Rapidly changing pesticide concentrations during these events require the use of automatic samplers for collections over the hydrograph. Each sample must be scanned for a wide variety of pesticides and samples frequently contain high concentrations of suspended sediments. An analytical procedure has been developed that focuses on those pesticides that can be directly extracted in methylene chloride and analyzed by capillary gas chromatography. The procedure includes: extraction with methylene chloride; sonication to break up sediment-extractant-water emulsions; drying over sodium sulfate (Na2SO4); concentration with Kuderna-Danish apparatus; transfer to isooctoane; and splitless injection into two capillary columns equipped with nitrogen-phosphorus thermionic detectors. The procedure provides quantification of the following pesticides: linuron, EPTC, butylate, ethoprop, trifluranlin, phorate, simazine, atrazine, terbufos, fonofos, diazinon, cyanazine, metribuzim, alachlor, metolachlor, chlorpyrifos, penoxalin, and two atrazine metabolites. The dual column injection allows simultaneous confirmation of 14 of the compounds listed above. The quality control (QC) program relies heavily on automated features of the analytical system. An autosampler allows analyses of a large number of QC samples including recalibration standards, blanks, replicates, spikes, and linearity checks. A data acquisition system provides chromatograms and detailed data reports for both capillary columns. Automatic transfer of the data reports to a computer system facilitates data quality review and data correction. The analytical procedure and associated quality control program provide an effective method for analyzing the large number of samples required in pesticide loading studies during runoff events in large rivers. (See also W88-11158) (Author's abstract)
W88-11166

QUALITY ASSURANCE FOR MICROBIOLOGICAL ANALYSES OF WATER,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
For primary bibliographic entry see Field 7C.
W88-11167

DEVELOPMENT OF STATISTICS AND LIMITS FOR DMR-QA STUDIES, AND SUMMARY OF EXPERIENCE IN DMR-QA STUDY 2,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Quality Assurance Branch.
For primary bibliographic entry see Field 7C.
W88-11170

PULP AND PAPER INDUSTRY EXPERIENCE WITH NPDES QUALITY ASSURANCE REQUIREMENTS,
National Council of the Paper Industry for Air and Stream Improvement, Inc., Gainesville, FL.
For primary bibliographic entry see Field 7C.
W88-11171

MONSANTO ANALYTICAL TESTING PROGRAM FOR NPDES DISCHARGE SELF-MONITORING,
Monsanto Research Corp., St. Louis, MO.
For primary bibliographic entry see Field 7C.
W88-11172

DISCHARGE MONITORING REPORT QUALITY ASSURANCE RESULTS AND FOLLOW-UP BY REGION VIII U.S. ENVIRONMENTAL PROTECTION AGENCY,
Environmental Protection Agency, Denver, CO. Region VIII.
For primary bibliographic entry see Field 7C.
W88-11173

QUALITY ASSURANCE IN ACID PRECIPITATION MEASUREMENTS,
Martin Marietta Environmental Systems, Colum-

bia, MD.
For primary bibliographic entry see Field 7C.
W88-11174

NEW BIOLOGICAL REFERENCE MATERIALS - IN VIVO INCORPORATED TOXIC METALS IN WATER HYACINTH TISSUES,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
J. R. Austin, S. J. Simon, L. R. Williams, and W. F. Beckert.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 305-317, 1 fig, 4 tab, 3 ref.

Descriptors: *Quality control, Aquatic plants, *Pollutant identification, *Water hyacinth, *Guidelines, *Standard reference materials, Chemical analysis, Arsenic, Cadmium. Lead, Mercury, Biological samples, Toxicity, Hydroponics.

Chemical analysts need biological reference materials that contain higher levels of toxic elements than are usually present in natural-source materials (e.g., orchard leaves, tomato leaves, or pine needles, available from the National Bureau of Standards (NBS)). The purpose of this study was to demonstrate that high-quality reference materials, containing high levels of multiple toxic elements, can be produced with in vivo incorporation procedures. The approach taken was to produce water hyacinth tissue materials - leaves and stems containing high levels of arsenic, cadmium, lead, and mercury - as follows: (1) apply a hydroponic feeding procedure for the in vivo incorporation of toxic elements into water hyacinths; (2) dry, blend, and homogenize the plant materials and determine the levels of the incorporated elements and the homogeneity of the generated plant material; (3) demonstrate that low-level control materials can be successfully blended with high-level materials to yield a homogeneous material with intermediate toxicant levels; (4) evaluate the precision of the analytical methods used to determine toxic element levels in the materials; and (5) evaluate the stability of the resulting materials. Sufficient quantities of the parent materials were produced so that characterized reference materials can now be made available on request. Levels of the toxic elements incorporated in water hyacinth leaves were 100, 300, 60, and 27 times the levels present in the control leaves for arsenic, cadmium, lead, and mercury, respectively. Overall precision of sampling, subsampling, and digestion, and chemical analysis of the treated materials were found to be homogeneous, and the overall analytical precision was comparable to that achieved for the control or treated materials alone. No significant changes were noted in control and treated materials in long-term (six months or more) stability studies. (See also W88-11158) (Author's abstract)
W88-11175

USE OF NATURAL WATERS AS U.S. GEOLOGICAL SURVEY REFERENCE SAMPLES,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 7B.
W88-11176

ROLE OF NBS STANDARD REFERENCE MATERIALS IN QUALITY ASSURANCE OF ENVIRONMENTAL MEASUREMENTS,
National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.
For primary bibliographic entry see Field 7C.
W88-11177

REFERENCE MATERIALS AND INTERCOMPARISON SAMPLES AVAILABLE FROM THE ENVIRONMENTAL MONITORING SYSTEMS LABORATORY - LAS VEGAS,
Environmental Monitoring Systems Lab., Las Vegas, NV.
E. J. Kantor, and P. R. Laska.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 360-369, 9 tab.

Descriptors: *Quality control, *Pollutant identification, *Water analysis, *Water quality, *Administrative agencies, *Administrative regulations, Pesticides, Toxicity, Organic compounds, Radioactive tracers, Sludge, Pollutants, Monitoring, Oil shale.

Reference materials and intercomparison samples may be obtained by laboratories involved in the analysis of environmental samples containing radioactivity, pesticides, toxic inorganic species, or toxic organic species. These reference materials and intercomparison samples are available from the U.s. Environmental Protection Agency's Quality Assurance Division located at the Environmental Monitoring Systems Laboratory in Las Vegas (EMS-LV). These materials are useful for incorporation into a laboratory's quality control program for the evaluation of the precision and accuracy of analytical work. Media used for radiation reference materials are pitchblende, Monazite ore, uranium mill tailings, Mancos shale, fly ash, and water spiked with radionuclides. Radioactivity intercomparison samples consist of water, milk, air, urine, and a simulated diet slurry spiked with radionuclides. Media available for toxic organic reference materials are sludge, shale oil, and rag oil, and for intercomparison samples are soil and water. Characterized fly ash, foundry sludge, and river sediment serve as reference materials for toxic inorganics, while spiked soil and water serve as intercomparison samples. Finally, spiked adipose tissue, blood plasma, urine, and water comprise the pesticide intercomparison samples, the laboratory can use the samples as reference materials. The reference materials are generally available continuously, but the intercomparison samples are distributed on a scheduled basis and in some cases only to certain laboratories. (See also W88-11158) (Author's abstract)
W88-11178

REFERENCE SAMPLES FOR WATER-RELATED PROGRAMS IN THE U.S. ENVIRONMENTAL PROTECTION AGENCY,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Quality Assurance Branch.
J. A. Winter.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 378-388, 6 tab.

Descriptors: *Pollutant identification, *Quality control, *Water analysis, *Sampling, *Water sampling, Administrative regulations, Legal aspects, Administrative agencies, Water quality, Laboratories, Guidelines.

The Environmental Monitoring and Support Laboratory at Cincinnati provides quality assurance (QA) support for U.S. Environmental Protection Agency (EPA) water-related programs in response to the Clean Water Act (PL 92-500), the Safe Drinking Water Act (PL 93-523), the Marine Protection, Research, and Sanctuaries Act (P> 92-532), the Resources Conservation and Recovery Act (PL 96-510), and the Toxic Substance Control Act (PL 94-469), and their amendments. Two important segments of this support are the Quality Control Sample Program, which furnishes samples of known concentrations for use as independent checks on intralaboratory QA activities, and the EPA's Repository for Toxic and Hazardous Materials, which provides calibration standards an spiking solutions for trace organic analyses of interest to the Agency. Each series contains one or more analytes, with true or reference values. The samples and standards are prepared as the stable concentrated solutions in all-glass ampuls for dilution to volume, and analyses by EPA, its contractors and grantees, and other federal, state and local agencies. (See also W88-11158) (Author's abstract)
W88-11179

ESTABLISHING AN ENVIRONMENTAL QUALITY ASSURANCE PROGRAM,
Utah Univ. Research Inst., Salt Lake City. UBTL Div.
For primary bibliographic entry see Field 7C.
W88-11180

INTERLABORATORY QUALITY ASSURANCE ASPECTS OF THE INTERNATIONAL JOINT COMMISSION'S GREAT LAKES MONITORING PROGRAMS,
National Water Research Inst., Burlington (Ontario). Quality Assurance and Methods Section.
For primary bibliographic entry see Field 7C.
W88-11181

USE OF DRIVEN CASING TO SAMPLE MULTIPLE SHALLOW WATER-BEARING ZONES IN THE GULF COAST,
Davis (Ken E.) Associates, Baton Rouge, LA.
L. A. Gandl, and J. W. Webb.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 147-153.

Descriptors: *Monitoring, *Groundwater pollution, *Industrial wastes, *Water sampling, *Monitoring wells, Well casings, Drilling, Boreholes, Path of pollutants, Gulf Coast, Contamination.

In many areas of the Gulf Coast, shallow groundwater contamination, when encountered, may exist in multiple, discrete water-bearing zones within 100 feet of the surface. Such conditions have also been seen at depths of 100 feet+ in the overbank and backswamp deposits of major distributaries and tributaries of Louisiana rivers, most often at sites of the petrochemical industry. Groundwater sampling of these multiple shallow water-bearing zones can be prohibitively expensive if a monitor well must be completed in every zone to assure nonmixing of the samples. A less expensive and more expedient method, suitable for use in most of the Gulf Coastal regions as well as other areas of unconsolidated sediments, involves the use of driven or pushed casing. The driven casing is forced through a water-bearing zone after sampling, and into the underlying, confining clay. Sampling errors can result if confining zones are thin, and care must be taken not to drive the casing too far. (See also W88-11182) (Author's abstract)
W88-11192

TECHNIQUE USED TO DRILL MONITORING WELLS AT A HAZARDOUS WASTE SITE,
Environmental Protection Agency, Dallas, TX. Region VI.
E. W. Cooper, L. C. Thebeau, and E. L. Green.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 154-172, 3 fig, 2 tab.

Descriptors: *Groundwater pollution, *Texas, *Industrial wastes, *Chemical wastes, *Water sampling, *Monitoring wells, *Drilling, Path of pollutants, Hazardous materials, Organic compounds, Polychlorinated biphenyls, Oil industry, Abandoned wells, Sand, Storage tanks, Contamination.

The Geneva Industries site in southeast Houston, Texas is a bankrupt, abandoned chemical production and oil recycling facility. Leaking storage tanks and unlined earthen waste ponds caused surface contamination with PCBs (polychlorinated biphenyls) and other hazardous chemicals and contamination of the 35-foot and 100-foot water sands. An improperly plugged oil well near the center of the site caused concern that vertical migration might have occurred in the well and the deeper water-bearing sands might be contaminated. Usable-quality groundwater occurs to a depth of 2,200 feet in the area and the City of South Houston's water supply well field, located one-half mile from the site, utilizes sands in the 500 to 1,700 foot depth range. A monitoring well program was designed to drill four wells to test the deeper sands in close proximity to the abandoned oil well so reliable data could be obtained in the shortest possible time. The program required drilling through grossly contaminated surface sediments and contaminated water-bearing sands. Strict personal safety and quality control measures were required to protect the health of the persons associated with the project and prevent any cross contamination while

drilling or pumping the wells. (See also W88-11182) (Author's abstract)
W88-11193

INSTALLATION OF OBSERVATION WELLS ON HAZARDOUS-WASTE SITES IN KANSAS USING A HOLLOW-STEM AUGER,
Geological Survey, Lawrence, KS. Water Resources Div.
C. A. Perry, and R. J. Hart.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 173-179, 3 fig.

Descriptors: *Monitoring wells, *Drilling, *Kansas, *Hazardous wastes, *Groundwater pollution, *Observation wells, Aquifers, Contamination, Water sampling, Path of pollutants, Hazardous materials, Boreholes.

Non-contaminating procedures were used during the installation of 12 observation wells using a hollow-stem auger on three hazardous-wastesites in Kansas. Special preparation and precautions were taken to ensure that water samples were representative of the aquifer and were not subjected to additional contamination from the land surface or from upper levels in the borehole. These included a thorough cleaning of the hollow-stem auger and pipe casing, keeping borehole cuttings from dropping into the well while drilling, and not adding water to the borehole. These procedures are designed to prevent contamination of the groundwater by the well-installation method. Since the use of water during well installations could contaminate the aquifer or dilute contaminants already present in the aquifer, two methods of well installation that did not introduce outside water to the borehole and aquifer were used. The first method utilized a slotted 3/4-inch coupling that was attached to the bit plate of the hollow-stem auger, allowing formation water to enter the auger, thereby preventing sand-plug formation. This method proved to be adequate, except when drilling through clay layers, which tended to clog the slotted coupling. A second method utilized a screened well swab that allowed only formation water to enter the hollow-stem auger and prevented sand from plugging the auger when the bit plate was removed. (See also W88-11182) (Author's abstract)
W88-11194

ASSESSMENT OF INFLUENCE OF COMPLEX HYDROGEOLOGIC AND GEOCHEMICAL CONDITIONS ON RCRA GROUND WATER MONITORING RESULTS,
IT Corp., Houston, TX.
D. E. Reece, and J. Monti.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 180-190, 5 fig.

Descriptors: *Texas, *Geohyrdology, *Geochemistry, *Wastewater disposal, *Groundwater pollution, *Monitoring, *Path of pollutants, Sand, Silt, Clay, Dissolved solids, Organic carbon, Hydrogen ion concentration, Recharge, Contamination.

A site located in the southeastern Texas coastal area includes a surface impoundment area consisting of two earthen, partially below grade, synthetically lined ponds located side by side. The impoundments had been designed as a regulated unit under RCRA based solely on the criterion of pH of influent fluid. During operation of the unit under interim status, a groundwater monitoring program had been implemented. The monitoring system indicated significant variations which triggered a groundwater quality assessment program. The two permeable zones within the site exhibit a distinct difference in groundwater quality. The shallow zone has higher dissolved solids, total organic carbon, and pH relative to the deeper permeable zone. The chemical differences between the two zones may result from the local recharge, the lower overall permeability and thickness of the shallow sand and the higher content of silt and clay in the shallow sand. Comparison of samples from analyses of the same hydrogeologic regime (i.e., all monitor wells screened in the lower sand) revealed only minor variances in groundwater quality from upgradient to downgradient wells. No contamination of groundwater or of shallow soils underlying the impoundments was found. The impoundments were closed as a hazardous facility under interim status and reopened as a nonhazardous facility following modification of the waste stream discharge to the ponds. (See also W88-11182) (Sand-PTT)
W88-11195

STUDY OF GROUND WATER FROM AN AGRICULTURAL AREA,
Alabama Univ., University.
For primary bibliographic entry see Field 5B.
W88-11210

PROCEEDINGS OF THE NWWA/API CONFERENCE ON PETROLEUM HYDROCARBONS AND ORGANIC CHEMICALS IN GROUND WATER: PREVENTION, DETECTION AND RESTORATION.
National Water Well Association, Dublin, OH.
For primary bibliographic entry see Field 5G.
W88-11213

NEW APPROACHES TO THE EVALUATION OF LEAK DETECTION MONITORS FOR UNDERGROUND STORAGE TANKS,
Environmental Monitoring Systems Lab., Las Vegas, NV.
J. J. van Ee.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 3-20, 5 fig, 5 tab, 4 ref.

Descriptors: *Seepage, *Groundwater pollution, *Network design, *Monitoring, *Leakage, Data interpretation, Data acquisition, Regulations.

The U.S. Environmental Protection Agency (EPA) is directed under the 1984 Resource Conservation and Recovery Act Amendments to develop regulations for underground storage tanks (USTs). Research on the various leak detection methodologies is an integral part of the process to develop regulations. This paper covers four areas of this research: instrumentation evaluation, network design, data analysis, and technical guidance. A survey of currently available leak detection methods was conducted to obtain: (1) the performance specifications for a method and (2) a brief description of the test method that was used to measure the performance of the leak detection monitors. Data from the survey are presented. Questions on where a monitor should be placed, how many are required, and how often the monitor needs to be sampled are covered under the topic of network design. The rationale for the development of performance criteria and standard test procedures for the evaluation of leak detection monitors is outlined. Critical questions to the successful monitoring of leaks from underground storage tanks are highlighted. (See also W88-11213) (Author's abstract)
W88-11214

RAPID ASSESSMENT MODEL FOR SPILLS ON SOIL OF OILY FLUIDS THAT ARE IMMISCIBLE WITH WATER,
Canviro Consultants Ltd., Kitchener (Ontario).
D. E. Metcalfe, and G. Zukovs.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 128-150, 10 fig, 3 tab, 17 ref.

Descriptors: *Soil contamination, Path of pollutants, *Groundwater pollution, *Model studies, *Infiltration, *Immiscibility, Mathematical equations, Vetical flow, Environmental protection, Subsurface drainage, Nomograms.

A subsurface transport model has been developed for spills on soil of oily fluids that are immiscible with water. This rapid assessment tool has been developed for spill respondents who are not necessarily contaminant transport specialists. The assessment model is to be used in evaluating the environmental severity and impacts of spills and determining the need for emergency actions. As such, model inputs are limited to the key data requirements, with guidelines provided on the selection of those data. The model equations are presented in nomogram format, allowing the migration distances and times of the contaminant fluid to be graphically obtained. The model accounts for the downward migration of contaminant fluids and the behavior of these fluids at the water table, for both fluids that are less dense and more dense than water. The nomograms describing these phenomena are based on Darcian flow concepts and published experimental work. Step-by-step instructions are provided in a worksheet format on the specified times, the time of penetration to the water table, the extent of potential contamination at the water table, and the ultimate subsurface configuration of the contaminant fluid. (See also W88-11213) (Author's abstract)
W88-11221

FEASIBILITY OF INFRARED SPECTROSCOPIC IDENTIFICATION OF CRUDE OIL WASTE BRINES,
Michigan Dept. of Public Health, Lansing.
B. O. Fisher.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 273- 283, 5 fig, 1 tab, 17 ref.

Descriptors: *Infrared spectroscopy, *Brines, *Brine disposal, *Industrial wastes, *Pollutant identification, Organic compounds, Trace elements, Pattern recognition, Utah, Performance evaluation, Comparison studies, Forensic studies.

The applicability of infrared spectroscopy to the source identification of improperly disposed waste oil brines was assessed. Source identification of waste oil brines is amenable to infrared spectroscopy due to the presence of trace organics that are characteristic of the production horizon. These organic constituents absorb in the infrared and provide unique spectra that reflect the functional group constitution of the oil. Eighteen characteristic peaks in the spectra of oils were selected for generation of a sample 'fingerprint'. Sample fingerprints were analyzed and compared by a pattern recognition process to ascertain if the infrared spectra of oil residuals could be used to correctly identify the source of a waste oil brine. Crude oil samples and waste oil brine samples were obtained from the Pineview and Uinta Basin oil fields of Utah. Oil samples were frequently associated with environmental contaminants such as brine, water, soils, and other insoluble materials. Samples were stored at 0 C in glass jars or bottles with screw-cap lids to prevent degradation between sampling and sample analysis. Oil samples were prepared for infrared spectroscopic analysis by extraction with carbon disulfide, a non-polar solvent that is transparent in the infrared fingerprint region. It was concluded that infrared spectroscopy cannot be used for the forensic identification of waste oil brine; oils from within a single geographical region could not be definitively differentiated. (See also W88-11212) (Author's abstract)
W88-11230

DIRECT DETECTION OF HYDROCARBON AND ORGANIC CHEMICALS WITH GROUND PENETRATING RADAR AND COMPLEX RESISTIVITY,
Geological Survey, Denver, CO.
G. R. Olhoeft.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemi-

cals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 284-305, 11 fig, 1 tab, 35 ref.

Descriptors: *Geophysics, *Remote sensing, *Pollutant identification, *Organic compounds, *Hydrocarbons, *Resistivity, *Radar, Plumes, Mapping, Clay, Chemical properties, Physical properties, Pollutants, Groundwater pollution, Hazardous materials.

This paper demonstrates that geophysical techniques allow noninvasive investigation of the physical and chemical properties of the Earth. Mapping of organic or hydrocarbon hazardous waste plumes with these techniques at sites in Minnesota, Nevada, Louisiana and Florida is described. Both techniques described, radar and resistivity, have limitations that restrict their usefulness, and their limitations are nearly complementary. The presence of clay is required for complex resistivity to detect organics, but clay severely restricts the depth of investigation of radar. Radar works best above the water table and in environments with electrical resistivity greater than 30 ohm-m; whereas, complex resistivity works well below the water table and below 30 ohm-m. Radar readily measures the presence of water-insoluble contaminants that float on the water table, whereas complex resistivity measures the presence of water-soluble contaminants that react with clays. Complex resistivity measures the presence or absence of chemical processes in the ground. These include oxidation-reduction reactions (such as the corrosion of pyrite or metallic objects), inorganic ion exchange on the surfaces of clay minerals, and a variety of clay-organic reactions including organic ion exchange and catalysis. (See also W88-11213) (Author's abstract)
W88-11231

STATISTICAL REVIEW OF GROUND WATER DATA FROM WASTE DISPOSAL SITES,
Browing-Ferris Industries, Houston, TX.
T. C. McKee, R. C. Allison, G. D. Holtzclaw, and J. Shields.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 309-320, 1 fig, 8 tab, 41 ref.

Descriptors: *Groundwater pollution, *Monitoring, *Sampling, *On-site data collection, Organic compounds, Hydrogen ion concentration, Statistical analyses, Halogenated hydrocarbons, Statistics, Regulations, Data collections, Water quality.

Ground water monitoring data were collected at 77 sampling events at four chemical waste disposal sites. The computerized data base established on the basis of these samples yielded a total of 913 observations for pH, specific conductance, total organic carbon, and total organic halogen. Descriptive statistical analyses were performed on the data and two tests for determining significance, the Cochran's Approximation to the Behrens-Fisher Student's t-Test and the Wilcoxon Two-Sample Test, were applied to the data. A comparison of the results obtained. Although the Cochran's Approximation to the Behrens-Fisher Student's t-Test resulted in fewer incidents of significant difference detected between up-gradient and down-gradient water quality, the test procedure is based on the major assumption that the sample population is normally distributed. The lack of normality found in the data distribution, therefore, would violate a major assumption, thus rendering the results obtained invalid. Neither of the modifications to the Student's t-Test initiated by Behrens-Fisher or Cochran changed the requirements for normality. The use of the Wilcoxon test, therefore, in this situation is the indicated test of preference since it does not violate the assumption of normality. Although it would result in more stringent compliance monitoring requirements using the present small numbers of samples, this may change when larger sample sizes are analyzed. The disparity between the results of the Wilcoxon and Cochran test is yet another reason to reassess the current statistical testing requirements for ground water monitoring. (See also W88-11213) (Author's abstract)
W88-11232

STRATEGY FOR DETECTING SUBSURFACE ORGANIC CONTAMINANTS,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
E. G. Walther, A. M. Pitchford, and G. R. Olhoeft.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 357-381, 10 fig, 1 tab, 42 ref. US Air Force Contract 68-03-3245.

Descriptors: *Pollutant identification, *Hydrogeology, *Plumes, *Soil gases, *Organic compounds, *Groundwater pollution, Sand, Deep aquifers, Clay, Sampling, Leachates, Sewage, Landfills, Aquifers, Mapping.

This paper discusses the experience of a team of North American experts in hydrogeology, geophysics, and soil gas sampling and analysis in creating 10 hypothetical cases and suggesting a sequence of techniques for each in the detection and mapping of subsurface organic contaminants. Leaks of fuel, solvent, landfill and sewage leachates over sand and gravel aquifers, deep aquifers, connected aquifers, crystalline fractured rock, thick fissured clay, and karst terrain are included. Measurement techniques considered included electromagnetic induction, complex resistivity and ground-penetrating radar. In general, rapid and inexpensive geophysical and soil gas techniques are recommended to help optimize the placement of more expensive monitoring wells. The geophysical techniques are helpful in locating utilities and in defining the depth to the water table, aquitards, and bedrock, thus better specifying the design and placement of the wells. The soil gas measurements can locate areas of contamination. It is suggested that the value of monitoring wells can be increased through core sampling with analysis of the headspace. (See also W88-11213) (Author's abstract)
W88-11235

EVALUATION OF A PASSIVE SAMPLING SOIL-GAS SURVEY TECHNIQUE FOR DETECTING VOLATILE ORGANIC COMPOUNDS,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
H. B. Kerfoot, C. L. Mayer, and M. J. Miah.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 407- 407-419, 6 fig, 2 tab, 10 ref. US EPA Contract No. 68-03-3249.

Descriptors: *Pollutant identification, *Path of pollutants, *Sampling, *Volatility, *Organic compounds, *Groundwater pollution, *Aquifer management, *Soil gases, Performance evaluation, On-site data acquisition, Groundwater movement.

A passive-sampling soil-gas surveying technique using industrial hygiene samplers is described and results of a field evaluation above a chloroform-contaminated aquifer are given. The evaluation included assessment of the correlation of results with results of an earlier soil-gas survey at the site and with ground-water chloroform concentrations as well as an evaluation of the short-range precision of results. Results correlated strongly with results from a previous grab-sample soil-gas survey at the site and with results of ground-water analyses. The precision of the results was good, as indicated by values of the coefficient of variation of 14 percent to 24 percent among groups of four sample locations in a 1-meter square pattern and of 12 percent among results form 10 samplers at 1-meter intervals along a line parallel to the direction of groundwater flow. (See also W88-11213) (Author's abstract)
W88-11237

FIELD AND INTERPRETATION TECHNIQUES FOR DELINEATING SUBSURFACE PETROLEUM HYDROCARBON SPILLS USING SOIL GAS ANALYSIS,
Tracer Research Corp., Tucson, AZ.
O. D. Evans, and G. M. Thompson.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 444-455, 5 fig, 1 tab, 3 ref.

Descriptors: *Plumes, *Oil spills, *Groundwater pollution, *Petroleum, *Soil gases, *Path of pollutants, Spatial distribution, Oxidation-reduction potential, Biodegradation, Hydrocarbons.

Gas analysis was used to delineate the areal extent of subsurface petroleum hydrocarbon spills for two cases; one containing a fresh spill and one relatively older. A case study is presented comparing the techniques to be used during sampling and interpretation. Problems include other hydrocarbon sources in the soil and biodegradation of petroleum hydrocarbons in the soil due to aerobic conditions and redox potentials favoring oxidation. Depth profile samples taken in the field, showing hydrocarbon concentration in relation to depth, determine where the redox potentials begin to favor contour maps of petroleum specific compounds such as benzene, as well as total hydrocarbons, delineate the subsurface spill excluding interference from other hydrocarbon sources such as sewer lines. (See also W88-11213) (Author's abstract)
W88-11239

NEW TECHNOLOGY IN OIL CONTENT MONITORS,
Naval Sea Systems Command, Washington, DC.
For primary bibliographic entry see Field 5G.
W88-11262

EVALUATION OF SURVEY POSITIONING METHODS FOR NEARSHORE MARINE AND ESTUARINE WATERS.
Tetra Tech, Inc., Bellevue, WA.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-221081. Price codes: A06 in paper copy, A01 in microfiche. EPA Report 430/9-86-003, March 1987. 110 p, 11 fig, 4 tab, 58 ref, 2 append. EPA Contract 68-01-6938.

Descriptors: *Water quality control, *Estuaries, *Coastal waters, *Surveys, *Navigation methods, *Data acquisition, Monitoring, Municipal wastes, Measuring instruments, Optical analysis, Microwaves, Electronic equipment, Satellite technology, Remote sensing.

Under regulations implementing Section 301(h) of the Clean Water Act, municipalities are required to conduct monitoring programs to evaluate the impact of their discharge on marine biota, to demonstrate compliance with applicable water quality standards, and to measure toxic substances in the discharge. This document provides essential information for the evaluation of operating characteristics (e.g., accuracy, precision, reliability) and system costs of station positioning equipment. Four main types of navigational instruments are considered in this document: optical techniques, electro-optical methods, electronic microwave systems, and satellite positioning equipment. Positioning for 301(h) monitoring programs is discussed along with the various advantages and disadvantages of each type of positioning system. A system selection procedure is also outlined to enable the designation of an appropriate positioning method to meet the needs of a given monitoring program. Further, methods are suggested to enhance system operational characteristics to minimize positional errors. (Lantz-PTT)
W88-11266

WATER QUALITY OF INTERSTATE STREAMS IN THE SUSQUEHANNA RIVER BASIN MONITORING REPORT FOR 1986 AND 1987 WATER YEARS,
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 7B.
W88-11285

5B. Sources Of Pollution

INFLUENCE OF A FRESHWATER RIVERINE MARSH FOR TERTIARY WASTEWATER TREATMENT IN THE UPPER BASIN OF THE B. EVERETT JORDAN RESERVOIR,
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-10089

GROUNDWATER TRANSPORT OF CHLOROPHENOLICS THROUGH A HIGHLY FRACTURED SOIL AT ALKALI LAKE, OREGON,
Oregon Graduate Center, Beaverton.
R. L. Johnson.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8613128. Ph.D. Dissertation, 1984. 251 p, 118 fig, 10 tab, 37 ref, 5 append.

Descriptors: *Path of pollutants, *Groundwater movement, *Groundwater pollution, *Waste disposal, *Chemical wastes, *Phenols, Fracture permeability, Advection, Diffusion coefficient, Dispersion, Sorption, Groundwater movement, Groundwater runoff, Mathematical models, Tracers.

Groundwater transport of chlorophenolic wastes at the chemical disposal site at Alkali Lake, Oregon were studied with emphasis on advection, molecular diffusion, dispersion, and sorption. The transport processes were characterized, the spatial distribution of the contaminants were measured, and the aquifer was conceptually and mathematically modeled. Groundwater transport near the site is facilitated by a large number of fractures in the soil. The shape of the contaminant distribution downgradient of the site is controlled by matrix diffusion, sorption, and drop off rapidly with distance immediately downgradient of the site primarily because of the nonuniform flow past the transport reference line. Variation in the local groundwater velocity and direction negate the ability of the one-dimensional equivalent porous medium model to predict contaminant distribution. Contaminant transport distance, results of tracer tests, and fluid mechanical calculations based on aquifer properties suggest that transport velocities from the site are much less than the groundwater velocity in the fractures, owing to the retarding effects of matrix diffusion and sorption. (Cremmins-AEPCO)
W88-10094

EFFECTS OF FLY ASH AND FLUE-GAS DESULFURIZATION WASTES ON GROUNDWATER QUALITY IN A RECLAIMED LIGNITE STRIP MINE DISPOSAL SITE,
North Dakota Univ., Grand Forks. Dept. of Geology.
F. W. Beaver.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8702462. Ph.D. Dissertation, 1986. 447 p, 256 fig, 6 tab, 29 ref, 5 append.

Descriptors: *Fly ash, *Sulfur, *Groundwater pollution, *Lignite, *Coal mining, Strip mine wastes, Leachates, Geochemistry, Permeability coefficient.

Hydrogeological and hydrochemical analyses were used to determine the effects of fly ash and flue-gas desulfurization (FGD) wastes on groundwater quality in a reclaimed lignite strip mine setting. After hydraulic gradients were determined, sets of piezometers, pressure-vacuum lysimeters, and coring data were defined. The hydrogeochemical data indicate that the fly ash and FGD waste initially generate highly mineralized leachates from entrained water. The leachates are characterized by high Na, Mo, Se, As and SO4 concentrations. Fly ash generates high pH leachate; while FGD wastes produce normal pH values. Leachate pH is quickly buffered to the 6 to 9 range within the sediments. Arsenic and selenium are simultaneously attenuated to acceptable levels. Iron hydroxide coatings on the sediments from alternate wetting and drying cycles may provide a mechanism for alkaline pH buffering with concurrent arsenic and selenium adsorption. Lead, Cadmium, and barium are maintained at low levels by sulfate and carbonate precipitation reactions. Molybdenum remains mobile in this hydrogeochemical setting. The cation exchange capacity of Na-montmorillonite clays may account for decreases in calcium and increases in sodium concentration levels with depth. (Cremmins-AEPCO)
W88-10099

WATER QUALITY CLASSIFICATION OF INLAND WATERS IN FINLAND,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5A.
W88-10120

AQUEOUS SOLUBILITY OF SELECTED BIPHENYL, FURAN, AND DIOXIN CONGENERS,
Utah State Univ., Logan. Div. of Environmental Engineering.
W. J. Doucette, and A. W. Andren.
Chemosphere CMSHAF, Vol. 17, No. 2, p 243-252, 1988. 4 tab, 8 ref. Federal Grant NA800-AA-D-0086, Project R/MW-21.

Descriptors: *Path of pollutants, *Solubility, *Organic compounds, *Hydrocarbons, *Chemical properties, *Polychlorinated biphenyls, Mathematical equations, Enthalpy, Thermal properties.

A generator-column technique was used in this study to measure the aqueous solubility of 13 individual PCB, PBB, methylbiphyenyl, PCDF, and PCDD isomers at several different temperatures. The data obtained were combined with other literature values, measured at 25 C using similar techniques, to create an accurate set of solubility values for high molecular weight aromatic hydrocarbons. Empirical equations expressing the variation of solubility with temperature are presented for each compound. Enthalpies of solution, calculated from van't Hoff plots, are also given. Aqueous solubilities of the hydrocarbons increased as much as 11 times for temperature increases of 4 to 40 C. Enthalpies of solution calculated from log x vs 1/T plots ranged from 6.5 to 17.8 kcal/mole. An expression was developed that can be used to estimate the aqueous solubility of aromatic hydrocarbons at any temperature ranging from 4 to 40 C if the solubility value at 25 C is known or can be estimated. (Friedmann-PTT)
W88-10134

SOLUBILITY OF AROMATIC POLLUTANTS IN MIXED SOLVENTS,
Arizona Univ., Tucson. Coll. of Pharmacy.
K. R. Morris, R. Abramowitz, R. Pinal, P. Davis, and S. H. Yalkowsky.
Chemosphere CMSHAF, Vol. 17, No. 2, p 285-298, 1988. 3 fig, 4 tab, 7 ref. EPA Cooperative Agreement CR-812581-01.

Descriptors: *Waste disposal, *Industrial waste, *Aromatic compounds, *Polynuclear aromatic hydrocarbons, *Solvents, *Solubility, Chemical properties, Pollutants, Hydrocarbons, Mathematical models, Water properties.

Pollutants in mixed-solvent industrial effluent may remain in solution or may precipitate on contact with water; the ability to predict a system's behavior depends on predicting the mixed solvent as well as the aqueous solubility. The solubility behavior of several aromatic and polynuclear aromatic pollutants was determined in a variety of water/cosolvent mixtures. The data were used to test a log-linear solubility model and develop a relationship for determining the slope of the log-linear solubility curve. The log-linear model did a reasonable job of describing the solubility behavior of the solutes in the solvent systems studied. The maximum error was less than an order of magnitude, usually substantially less. The utility of the model lies in its simplicity. Only three components are needed to estimate the solubility of a solute in a mixed aqueous solvent of any composition: the a and b values for the binary solvent system, and the MP value (melting point of the compound - assumed to be 25 C for liquids) and log p (p = the octanol-water partition coefficient of the solute). (Friedmann-PTT)
W88-10135

ENRICHED CONCENTRATIONS OF BROMINE, CHLORINE, AND IODINE IN URBAN RAINFALL AS DETERMINED BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS,
Illinois Univ. at Urbana-Champaign. Dept. of Nuclear Engineering.
S. Landsberger, J. J. Drake, and S. J. Vermette.
Chemosphere CMSHAF, Vol. 17, No. 2, p 299-307, 1988. 4 fig, 2 tab, 24 ref.

Descriptors: *Urban areas, *Chemistry of precipitation, *Air pollution, *Bromine, *Chlorine, *Iodine, *Halogens, Water pollution sources, Enrichment, Neutron activation analysis.

Concentrations of bromine, chlorine and iodine were determined in bulk rain as part of a detailed urban monitoring program. Instrumental neutron activation gives simultaneous non-destructive analysis of these halogens with detection limits of 2, 30 and 1 ng/g for bromine, chlorine, and iodine, respectively. Results for enrichment factor calculations based on crustal, seawater and lake water reference elements were somewhat contradictory. Elemental ratios of Br/Cl, I/CL, Br/PB, and Cl/Pb, together with an analysis of chlorine in urban surface materials, support the suggestions that local anthropogenic sources may cause the high bromine and chlorine concentrations observed in urban precipitation while fractionation from an oceanic source is likely responsible for high iodine concentrations. (Author's abstract)
W88-10136

PITFALLS IN THE AQUATIC PHOTOCHEMISTRY TESTING OF CHLORINATED AROMATIC COMPOUNDS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Ecotoxicology, Environmental Chemistry, and Drinking Water.
For primary bibliographic entry see Field 5A.
W88-10139

BIOACCUMULATION OF HALOGENATED AROMATIC HYDROCARBONS IN C57B1/6 AND DBA/2 MICE FOLLOWING CONSUMPTION OF GREAT LAKES COHO SALMON (ONCORHYNCHUS KISUTCH),
McMaster Univ., Hamilton (Ontario). Dept. of Pathology.
G. B. Cleland, B. G. Oliver, and R. A. Sonstegard.
Chemosphere CMSHAF, Vol. 17, No. 2, p 405-420, 1988. 6 tab, 22 ref.

Descriptors: *Path of pollutants, *Pollutant identification, *Bioassay, *Population exposure, *Metabolism, *Salmon, *Mice, *Polychlorinated biphenyls, *Animal tissues, *Bioaccumulation, Water pollution effects, Hydrocarbons, Diets, Great Lakes, Baseline studies.

This study was designed to provide comprehensive baseline determinations of the levels of polychlorinated biphenyl (PCB) isomers and congeners (as well as several other organochlorine pollutants) in coho salmon from three of the Great Lakes and from the Pacific Ocean. Following dietary exposure to these fish, the subsequent levels and bioaccumulation patterns of these pollutants were examined and compared in liver tissues of C57B1/6 (Ah+) and DBA/2 (Ah-) mice. Gradation of PCB isomer and congener levels were found in coho salmon from Lakes Erie, Michigan and Ontario. A

similar bioaccumulation pattern was observed in mouse livers following consumption of Great Lakes fish and, in general, the levels were higher in C57B1/6 than in DBA/2 mice. (Friedmann-PTT)
W88-10140

HEAVY METAL LEVELS IN THREE SPECIES OF FISH IN TJEUKEMEER, A DUTCH POLDER LAKE,
Euro Consultants, Sholing (England).
K. S. Badsha, and C. R. Goldspink.
Chemosphere CMSHAF, Vol. 17, No. 2, p 459-463, 1988. 3 tab, 7 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Netherlands, *Bioaccumulation, *Population exposure, Water pollution effects, Fish populations, Lead, Mercury, Metabolism, Industrial pollution, Eels, Roach, Lakes.

Analyses of heavy metals in three species of freshwater fish from a typical Dutch Polder Lake (Tjeukemeer) are presented. Levels are generally low, reflecting the distance of the lake from the centers of industry. Levels of lead and mercury in eels calls for some concern in view of their consumption by humans. Detailed studies of lead burdens in roach stress the significance of the liver as a major receptor of this metal. Lead levels in the liver relative to the total fish increase from 0.76 - 4.64% in roach from 50 - 350 mm in length. (Author's abstract)
W88-10142

NITRATED PHENOLS IN RAIN: ATMOSPHERIC OCCURRENCE OF PHYTOTOXIC POLLUTANTS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
C. Leuenberger, J. Czuczwa, J. Tremp, and W. Giger.
Chemosphere CMSHAF, Vol. 17, No. 3, p 511-515, 1988. 1 fig, 2 tab, 34 ref.

Descriptors: *Phenols, *Path of pollutants, *Air pollution, *Hydrocarbons, Water pollution effects, Population exposure, Herbicides, Gas chromatography, Spectrometry, Chemical analysis, Chemical processes, Rain, Simulation, Chemistry of precipitation, Air pollution effects.

Nitrated organic pollutants in the atmosphere (e.g. peroxyacetylnitrate) and nitrated polycyclic aromatic hydrocarbons have been extensively studied due to their possible hazardous effects on human and plant life. We report here the determination of six nitro- and three dinitrophenols in rain samples collected at an urban site in Switzerland. Identifications were performed by high-resolution gas chromatography/mass spectrometry. 2,4-Dinitro-6-methylphenol was present at concentrations between 1 and 10 nM. Although dinitrophenols are used as herbicides and insecticides, recently reported smog chamber experiments indicate that nitrated phenols could be secondary pollutants formed by tropospheric transformation of monoaromatic chemicals such as toluene and methylphenols. Rain and air measurements of these primary aromatic contaminants and of reactive species (NOx, ozone) suggest that these compounds might be the precursors of nitrated phenols. Nitrated phenols are known to act as uncoupling agents in oxidative phosphorylation and to affect cell metabolism at levels lower than 10 microM. Such toxic compounds in rainwater could act as previously unidentified stress factors for trees and should be evaluated as possible causes for the forest decline observed in central Europe with dramatically increasing severity since 1980. (Author's abstract)
W88-10143

PHOTOLYSIS OF RHODAMINE-WT DYE,
Geological Survey, NSTL Station, MS.
For primary bibliographic entry see Field 7B.
W88-10144

MEASURED AND MODELED FATE OF DISPERSE YELLOW 42 IN AN OUTDOOR POND,
Bayreuth Univ. (Germany, F.R.). Fakultaet fuer Biologie, Chemie, Geowissenschaften.
For primary bibliographic entry see Field 7B.
W88-10145

PHOTOLYSIS OF ALKYLATED NAPHTHALENES IN AQUATIC SYSTEMS,
Tokyo Univ. of Fisheries (Japan). Dept. of Marine Environmental Science and Technology.
K. Fukuda, Y. Inagaki, T. Maruyama, H. Imamura Kojima, and T. Yoshida.
Chemosphere CMSHAF, Vol. 17, No. 4, p 651-659, 1988. 5 fig, 8 tab, 33 ref.

Descriptors: *Path of pollutants, *Hydrocarbons, *Fate of pollutants, *Photolysis, *Chemical degradation, *Aquatic environment, Chemical properties, Seawater, Organic compounds.

The photodegradability in aquatic systems of some alkylated naphthalenes and related compounds was studied using a high-pressure mercury lamp. The rate constant and half-life of their degradation were estimated in distilled water. From the results performed in artificial seawater, which served as a marine environmental model, the rate of photolysis of alkylated naphthalenes increased several times over that in distilled water. This was especially observed for naphthalene. Therefore, sodium chloride, the main component of seawater, was estimated to be the cause of the enhancement, because the rate increased nearly proportionally to the concentration of NaCl in the system, with a correlation coefficient of 0.995 for 2-isopropylnaphthalene. (Author's abstract)
W88-10149

VAPOR-PHASE ADSORPTION OF ALKYLBENZENES AND WATER ON SOILS AND CLAYS,
Florida Univ., Gainesville. Dept. of Soil Science.
R. D. Rhue, P. S. C. Rao, and R. E. Smith.
Chemosphere CMSHAF, Vol. 17, No. 4, p 727-741, 1988. 5 fig, 5 tab, 30 ref. USAF Contract No. FO8635-83-C-0135.

Descriptors: *Benzenes, *Path of pollutants, *Adsorption, *Organic compounds, *Soil chemistry, *Soil adsorption capacity, Chemical properties, Spectrophotometry, Reagents, Model studies, Clays.

Vapor-phase adsorption of water and three alkylbenzenes (toluene, p-xylene, and ethylbenzene) on bentonite, kaolin, two soil samples, an aquifer material, and a silica gel were measured by a procedure in which vapor-phase concentrations were measured by trapping the vapors in methanol and adsorbed-phase concentrations were measured by methanol-extraction. Water in the methanol was measured by titration with Karl Fischer reagent; alkylbenzenes were measured by UV spectrophotometry and/or high-performance liquid chromatography analysis. Bentonite and the two soil samples adsorbed much more water than alkylbenzene. Kaolin adsorbed nearly equal amounts of water and alkylbenzene, while silica gel adsorbed nearly twice as much of the alkylbenzenes as water. With the exception of water adsorption on bentonite and alkylbenzene adsorption on Olsmar soil (Alfic Arenic Haplaquod), adsorption conformed to type-II adsorption isotherms that were adequately described by the BET adsorption model. Surface areas calculated from BET monolayer capacities indicated that the surface available for alkylbenzene adsorption was essentially that measured by N2 adsorption except for silica gel. Values for the relative adsorption (the amount adsorbed divided by the monolayer capacity as determined by the BET model) of water and p-xylene were similar for several of the adsorbents used. (Author's abstract)
W88-10150

ESTABLISHMENT OF A TEST GUIDELINE FOR THE EVALUATION OF FISH TAINTING,
European Chemical Industry Ecology and Toxicology Centre, Brussels (Belgium).
For primary bibliographic entry see Field 7C.
W88-10151

TOXICOLOGICAL APPROACH FOR DETECTING ORGANIC MICROPOLLUTANTS IN ENVRIONMENTAL SAMPLES,
Istituto di Ricerca sulle Acque, Milan (Italy).
For primary bibliographic entry see Field 5A.
W88-10153

ATMOSPHERIC CONTAMINATION WITH POLYCHLORINATED BIPHENYLS IN BELA KRAJINA (YUGOSLAVIA): EMISSIONS FROM INDUSTRIAL PLANT, LANDFILL, AND RIVER AREAS,
Public Health Inst. of Slovenia, Lujubijana (Yugoslavia).
J. Jan, M. Tratnik, and A. Kenda.
Chemosphere CMSHAF, Vol. 17, No. 4, p 809-813, 1988. 1 fig, 17 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Polychlorinated biphenyls, Pollutant identification, Gas liquid chromatography, Organic pollutants, Industrial waste, Emissions, Landfills, Chemical properties, Air pollution, Yugoslavia.

Atmospheric transport of polychlorinated biphenyls (PCBs) from pollution in Bela krajina (Yugoslavia) is described. The mean PCB levels, analyzed by high resolution capillary GL chromatography were as follows in the air samples from the factory, 2000 ug/cu m; at a distance of 300 m from the factory, 5 ug/cu m; from the waste landfill, 45 ug/cu m; and from river water 3 ug/cu m. Changes in the PCB profile of atmospheric emissions from industrial waste plant, landfill and river water were explained in terms of the differences in physico-chemical properties of single PCB congeners. The congeners with higher volatility and with higher orthochlorine substitution were enriched through air transport. (Author's abstract)
W88-10154

IMPACT OF A SINGLE BLACK SNOWFALL ON STREAMWATER CHEMISTRY IN THE SCOTTISH HIGHLANDS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
M. Tranter, P. W. Abrahams, I. L. Blackwood, P. Brimblecombe, and T. D. Davies.
Nature NATUAS, Vol. 332, No. 6167, p 826-829, April 28 1988. 3 fig, 3 tab, 26 ref.

Descriptors: *Black snow, *Water pollution sources, *Path of pollutants, *Snowmelt, *Snowfall, *Chemistry of precipitation, *Acid rain, *Water pollution effects, Hydrogen ion concentration, Ions, Snow, Snowpack, Spatial distribution, Scotland, Mountain stream, Water pollution, Acid streams.

During snowmelt, ions fractionate into the first meltwaters giving rise to concentrated, often acidic, solutions. This may cause transient acidification of streamwaters (so-called 'acid flush') in poorly buffered upland catchments which can kill fish or, more commonly, cause recruitment failure. The chemistry of snow and meltwater can affect the magnitude and duration of the acid flush, particularly when stream discharge is not dominated by pre-event water. Such conditions are found in upland Britain, in the Scottish Highlands. The most acidic snowfalls in the Highlands are colored or black and occur under specific meteorological conditions. Presented here is the streamwater chemistry during two acid-flush events with minimum recorded pH of 4.25 and 4.10. An acidic black snow (pH 3.4) fell in the 8-day period between the events. The meltwater composition during the first event was influenced by the composition of the existing snowcover, whereas the second event shows the effect of the fall of polluted snow. These observations demonstrate that a single snowfall can strongly influence the composition of meltwaters. Therefore, the large-scale distribution of ions in snowpacks must be considered in attempting to predict the magnitude of acidification during the thaw and the possible impact of acid rain on aquatic ecosystems. This works highlights how chance association of episodic events (colored snowfall and snowmelt) may amplify acidification in streamwater. (Author's abstract)

W88-10161

QUANTITATIVE ASSESSMENT OF WORLD-WIDE CONTAMINATION OF AIR, WATER AND SOILS BY TRACE METALS,
National Water Research Inst., Burlington (Ontario).
J. O. Nriagu, and J. M. Pacyna.
Nature NATUAS, Vol. 333, No. 6169, p 134-139, May 12 1988. 5 tab, 48 ref.

Descriptors: *Path of pollutants, *Trace metals, *Cycling metals, *Water pollution sources, *Air pollution, *Toxicity, Soil contamination, Food chains, Industrial wastes, Municipal wastes, Cadmium, Copper, Nickel, Lead, Zinc, Tin, Selenium, Vanadium, Molybdenum, Mercury, Arsenic, Population exposure.

Calculated loading rates of trace metals into the three environmental compartments demonstrate that human activities now have major impacts on the global and regional cycles of most of the trace elements. There is significant contamination of freshwater resources and an accelerating accumulation of toxic metals in the human food chain. The inventories presented here show that mankind has become the most important element in the global biogeochemical cycling of trace metals. The man-induced mobilization of trace metals into the biosphere (median values in thousand tonnes per year of the terrestrial plus aquatic inputs minus atmospheric emissions) comes to about 120 for As, 30 for Cd, 2150 for Cu, 11 for Hg, 110 for Mo, 470 for Ni, 1160 for Pb, 72 for Sb, 79 for Se, 71 for V, and 2340 for Zn. The annual total toxicity of all the metals mobilized exceeds the combined total toxicity of all the radioactive and organic wastes generated each year (as measured by the quantity of water needed to dilute such wastes to drinking water standard). Each year, millions of tonnes of 'new' trace metals are produced from the mines and subsequently redistributed in the biosphere. The greatly increased circulation of toxic metals through the soils, water and air and their inevitable transfer to the human food chain remains an important environmental issue which entails some unknown health risks for future generations. (Miller-PTT)
W88-10164

DEPENDENCE OF THE CHEMICAL COMPOSITION OF THE WATER IN THE RIVER RUDAWA (SOUTHERN POLAND) ON ITS FLOW,
Polish Academy of Sciences, Krakow. Inst. of Botany.
K. Chmielinska.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 3, p 283-297, 1985. 4 fig, 6 tab, 14 ref.

Descriptors: *Water quality, *Water pollution sources, *Nonpoint pollution sources, *Rudawa River, *Path of pollutants, *Eutrophication, *Poland, Vistula River, Catchment area, Minerals, Sulfates, Chlorides, Nitrates, Rivers, Chemical composition, Flow discharge.

The catchment area of the Rudawa River, a left tributary of the Vistula River, is intensively farmed. The dependence of the chemical composition of water on the magnitude of the flow was analyzed. Because there were no distinct changes in the concentration of different compounds with the level of flow except for nitrate nitrogen, the total load depended mainly upon the magnitude of flow. Two periods of investigation, 1957 to 1964 and 1971 to 1980, were compared. An increase in the content of sulfates, chlorides and mineral nutrients was observed. The trophic condition of the river is basically affected by the agricultural use of the basin, because the chemical composition of soils in the deeper layers of the substrate and soil cultivation are decisive in the amount of nutrients flowing into the river. (Miller-PTT)
W88-10171

ESTIMATION OF QUALITY OF SOME SURFACE WATERS NEAR THE UPPER SILESIA USING THE ALGAL GROWTH TEST,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
T. Betnarz.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 3, p 331-338, 1985. 3 fig, 16 ref.

Descriptors: *Surface water, *Rivers, *Water pollution effects, *Water quality, *Heavy metals, *Algal growth, *Poland, *Upper Silesia, Catchment areas, Bioassay, Zinc, Lead, Cadmium, River Mala Panew, River Brynica, Reservoirs, Chlorella.

In the period 1977-79, the pollution level of waters (rivers and reservoirs) belonging to the catchment area of the Rivers Mala Panew and Brynica (Poland) were estimated by applying the bioassay technique using Chlorella pyrenoidosa. Pollution of waters of the Mala Panew catchment area with zinc, lead and cadmium was shown. The zinc and lead concentrations exceeded those toxic for Chlorella. In the waters of the Brynica catchment area, no great pollution was found but a varying nutrient level was apparent. (Author's abstract)
W88-10174

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS): 14. THE USE OF THE EXPERIMENTAL STREAM METHOD IN EVALUATING THE EFFECT OF AGRICULTURAL POLLUTION,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10176

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 1. RANGE AND AIMS OF THE INVESTIGATION WITH A DESCRIPTION OF THE ENVIRONMENT,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. Zieba.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 423-432, 1985. 1 fig, 1 tab, 13 ref.

Descriptors: *Upper Silesian Industrial Region, *Ecology, *Poland, *Water pollution effects, *Agricultural watersheds, *Industrial watersheds, *Eutrophication, Chemical properties, Physical properties, Algal growth, Heavy metals, Bacteria, Biocenoses, River Brynica, Path of pollutants, Monitoring, Bioassay, Rivers, Reservoirs, Lakes, Ponds, Water pollution, Catchment basins, Surveys.

Hydrobiological investigations in the waters of the River Brynica (Poland) were undertaken to obtain the following: (1) an extensive determination of the effect of industrial and agricultural pollution on water quality and usability and on various components of the biocenoses, (2) an at least partial reference of the recent results to earlier chemical, biological and ichthyological investigations, (3) the determination of the influence of river waters on the reservoir and of the reservoir on the river below the dam, (4) a general estimation of possible consequences of further water pollution in the catchment basin. Descriptions of the environment of the sampling stations and of the methods applied are given. The basic results of the environment features in the river and water bodies were obtained by means of full physico-chemical analysis. The role of nutrients contained in rainwater, river environment data, and usable water quality are named in relation to their eutrophicating effects. Methods discussed include: (1) the determination of heavy metals entering the water from the atmosphere, (2) the bacteriological estimation of the degree of water pollution, (3) the characterization of the aquatic environment using the algal growth test and (4) the determination of taxonomic structure of organisms within various ecological groups. (See W88-10178 thru W88-10188) (Miller-PTT)
W88-10177

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 2. CHEMICAL COMPOSITION OF THE WATER AND ATMOSPHERIC PRECIPITATION,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10178

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 3. CHEMICAL COMPOSITION OF THE WATER. HEAVY METALS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10179

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 4. ATMOSPHERIC HEAVY METAL POLLUTION OF THE BOTTOM OF THE RESERVOIR AT KOZLOWA GORA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 465-476, 1985. 1 fig, 6 tab, 37 ref.

Descriptors: *Path of pollutants, *Poland, *Agricultural watersheds, *Industrial watersheds, *Ecology, *Reservoirs, *Water pollution effects, *Heavy metals, Air pollution, Bottom sediments, Zinc, Lead, Cadmium, Upper Silesian Industrial Region, River Brynica, Water pollution sources, Temperature effects, Rivers.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. High contents of Zn, Pb, and Cd in the atmosphere of the Upper Silesian Industrial Region have led to the considerable, and in the course of time, increasing heavy metal pollution of the bottom sediments of the Kozlowa Gora reservoir situated in the vicinity. Apart from varied metal content in the different zones of the reservoir, their concentrations were, as a rule, higher in cold periods than in warm ones. Similarly, as in dusts from Silesia, a narrow ratio of Zn:Pb (close to 2:1) and a lower content of Cd (by two orders of magnitude) with respect to both metals were observed in the bottom sediments of the reservoir. (See W88-10177 thru W88-10179 and W88-10181 thru W88-10188) (Miller-PTT)
W88-10180

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 5. BACTERIOLOGICAL CHARACTERISTICS OF THE WATERS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Starzecka.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 477-492, 1985. 6 fig, 1 tab, 26 ref.

Descriptors: *Path of pollutants, *Poland, *Agricultural watersheds, *Industrial watersheds, *Ecology, *Water pollution sources, *Bacteria, Nitrogen compounds, Sulfur compounds, Water quality, Upper Silesian Industrial Region, River Brynica, Rivers, Reservoirs, Lakes, Ponds, Water pollution, Air pollution, Dusts, Bacterial analysis, Cycling nutrients, Water quality standards.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. The bacteriological characteristics of these water bodies are discussed. Quantitative changes in heterotrophic bacteria, which carried out the conversion of nitrogen and sulfur compounds, were deter-

mined for the period from May 1976 to May 1979. Water quality was classified according to four purity classes which varied in the value of the biological and chemical indices of pollution from class I (very pure waters) to class IV (very strongly polluted waters). The results suggest that the relatively pure River Brynica undergoes gradual, though slight, pollution in the sector from its springs to the Kozlowa Gora reservoir. this is due to surface run-off and dust emission from the air. (See W88-10177 thru W88-10180 and W88-10182 thru W88-10188) (Miller-PTT)
W88-10181

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 6. COMMUNITIES OF PLANKTON ALGAE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10182

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 8. CILIATA IN BOTTOM SEDIMENTS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10184

INFLUENCE OF CONTAMINATED PARTICLES ON THE BIOACCUMULATION OF HYDROPHOBIC ORGANIC MICROPOLLUTANTS IN FISH,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
A. Opperhuizen, and R. C. A. M. Stokkel.
Environmental Pollution, Vol. 51, No. 3, p 165-177, 1988. 4 fig, 2 tab, 23 ref.

Descriptors: *Path of pollutants, *Particulate matter, *Chlorinated hydrocarbons, *Bioaccumulation, *Hydrophobic organic micropollutants, *Fish, Water pollution effects, Fish diets, Contamination, Benzenes, Sorption, Solute transport.

The influence of contaminated particles on the bioconcentration of hydrophobic chemicals by fish is dependent on the hydrophobicity of the chemicals. This has been shown for polychlorinated benzenes and biphenyls (ranging over three orders of magnitude in octan-1-ol/water partition coefficient) which are sorbed on very low organic carbon content particles. For chemicals with low to moderate hydrophobicity, the amount of the chemical which is sorbed, relative to the amount which is dissolved, determines the influence that contaminated particles have on the uptake of the chemical by fish. In the present experiment, for lower chlorinated benzenes and biphenyls, the amounts dissolved in water are high compared with the amounts which are present in the sorbed state, and the influence of contaminated particles on their uptake by fish is negligible. For more hydrophobic chemicals, which have lower aqueous solubilities, such as penta- and hexachlorobenzene, and tri- and tetrachlorobiphenyls, contaminated particles can have a much greater influence on the uptake by fish. If the number of contaminated particles is sufficiently high, the low aqueous solubilities, in combination with relatively high rates of desorption or dissolution, enable the particles to act as a source of the hydrophobic chemicals. For extremely hydrophobic chemicals, the rates of dissolution or desorption determine the rates of uptake of the chemical by the fish. Hence, during relatively short periods of exposure, there is no influence of contaminated particles on the bioaccumulation. (Author's abstract)
W88-10195

CONCENTRATIONS OF CADMIUM AND OTHER METALS IN FUCUS VESICULOSUS L. AND FONTINALIS DALECARLICA BR. EUR. FROM THE NORTHERN BALTIC SEA AND THE SOUTHERN BOTHNIAN SEA,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
S. Soderlund, A. Forsberg, and M. Pedersen.
Environmental Pollution, Vol. 51, No. 3, p 197-212, 1988. 10 fig, 4 tab, 18 ref.

Descriptors: *Water pollution sources, *Cadmium, *Heavy metals, *Bioaccumulation, *Algae, *Mosses, *Path of pollutants, Industrial wastes, Zinc, Mine wastes, Fucus, Baltic Sea, Bothnian Sea, Tissue analysis, Aluminum, Cobalt, Copper, Iron, Manganese, Nickel, Lead, Vanadium, Aquatic mosses.

Concentrations of Cd and ten other metals (Al, Co, Cr, Cu, Fe, Mn, Ni, Pb, V and Zn) were determined in the brown seaweed Fucus vesiculosus L. and the aquatic moss, Fontinalis dalecarlica Br. Eur. from the northern Baltic Sea and the southern Bothnian Sea. Elevated concentrations of metals were found in samples taken close to densely populated areas, such as Stockholm and Nynashamn. Very high concentrations (especially Zn) were found in both Fucus and Fontinalis samples taken form the area south of the Gulf of Gavle. The results indicate that mining and industrial activities along the river Dalalven are the main sources of Zn and several other metals. Cd concentrations in Fucus plants reached maximum values (24.5 mg/kg) at the northern site. The gradual increase of Cd concentrations in Fucus plants northward could not be totally explained by the salinity gradient in the Baltic Sea; reasons for this are discussed in this paper. (Author's abstract)
W88-10196

EFFECTS OF IRRIGATION WITH RAW AND DIFFERENTIALLY DILUTED SEWAGE AND APPLICATION OF PRIMARY SETTLED SEWAGE-SLUDGE ON WHEAT PLANT GROWTH, CROP YIELD, ENZYMATIC CHANGES AND TRACE ELEMENT UPTAKE,
National Environmental Engineering Research Inst., Nagpur (India).
C. Chakrabarti, and T. Chakrabarti.
Environmental Pollution, Vol. 51, No. 3, p 219-235, 1988. 6 tab, 53 ref.

Descriptors: *Heavy metals, *Bioaccumulation, *Path of pollutants, *Wastewater irrigation, *Raw wastewater, *Primary sludge, *Wheat, Plant physiology, Crop yield, Enzymes, Trace metals, Wastewater dilution, India, Copper, Zinc, Chromium, Manganese, Metabolism.

An increase in the concentration of Cu, Zn, Cr and Mn, and a decrease in the activities of aspartate amino transferase, alanine amino transferase and peroxidase were observed in the different fractions of wheat plants, following raw and differentially diluted (66% and 50%) sewage irrigation and dry primary settled sewage-sludge amendments of soils. The grain enrichment efficiencies for Cu, Zn and Mn were significantly low under all experimental conditions. On the other hand, the grain enrichment efficiency for Cr was low under all sewage irrigation conditions only. Except in the earheads of wheat plants from sludge-amended soil, catalase activities were significantly low in roots, stems and earheads of wheat plants, under all other treatment conditions investigated. The decrease in the proteinase activity was statistically significant in roots and earheads of sewage-irrigated plants; the activity in the stem was low following irrigation with raw and 66% sewage only. Proteinase activity was also significantly low in all fractions of wheat plants harvested from soil amended with 20 tons of sludge per hectare. The observed results appear to be due to an overall decrease in the metabolic status of the plants following sewage irrigation and sludge amendment of soils. Grain yields, however, were not reduced despite this metabolic effect. (Author's abstract)
W88-10197

SEPTIC TANKS AS SOURCES OF PHOSPHORUS TO LOUGH ERNE, IRELAND,
University Coll., London (England). Palaeoecology Research Unit.
S. T. Patrick.
Journal of Environmental Management JEVMAW, Vol. 26, No. 3, p 239-248, April 1988. 2 fig, 4 tab, 41 ref. ESRC Grant HR 7437.

Descriptors: *Path of pollutant, *Ireland, *Northern Ireland, *Septic tanks, *Phosphorus, *Eutrophic lakes, *Rural areas, Wastewater pollution, Surveys, Catchment areas, Lough Erne, Water pollution sources.

The potential significance of septic tanks as sources of phosphorus to eutropic Lough Erne, Ireland, is examined by means of a survey of non-sewered households in the catchment. The provision of septic tanks is largely a feature of the past 20 years and was not complete as late as 1983. Phosphorus from septic tank sludge is likely to be of direct significance only at Enniskillen sewage disposal works. A distinct dichotomy is recognized between Northern Ireland sectors of the catchment, where septic tank effluent generally drains direct to watercourses, and sectors in the Republic where soil-soak systems predominate. The dichotomy is explained by administrative factors, not by differential soil conditions. It is concluded that septic tank effluent comprises a significant and hitherto unrecognized source of phosphorus to surface waters in the catchment. (Author's abstract)
W88-10199

HYDROCARBONS IDENTIFICATION IN 'HUIRO' (MACROCYSTIS PYRIFERA) FROM THE STRAIT OF MAGELLAN (IDENTIFICACION DE HIDROCARBUROS EN HUIRO (MACROCYSTIS PYRIFERA) DEL ESTRECHO DE MAGALLANES),
Universidad de Magallanes, Punta Arenas (Chile). Inst. de la Patagonia.
For primary bibliographic entry see Field 5A.
W88-10201

PREDICTION OF THREE-DIMENSIONAL THERMAL DISCHARGE FLOWS,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
G. D. Raithby, R. V. Elliott, and B. R. Hutchinson.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 720-737, July 1988. 10 fig, 33 ref.

Descriptors: *Path of pollutants, *Wastewater disposal, *Model studies, *Hydrologic models, *Lakes, *Thermal pollution, Discharge measurement, Mixing, Turbulent flow, Hydrodynamics, Flow characteristics.

A three-dimensional model that has been extensively used to predict the motion and mixing of thermal discharges entering lakes, uses a computational mesh that conforms to the bottom of the lake, the surface, and the shoreline, and is concentrated in the vicinity of the discharge. The k minus epsilon turbulence model (where k = turbulent kinetic energy and epsilon = its dissipation) is used to estimate the turbulent stresses and fluxes. The effects of bottom surface roughness as well as the enhanced mixing due to turbulence generation by an ice cover or wind are included, and either floating (summer) or sinking (winter) plumes can be predicted. New solution algorithms make the three-dimensional model relatively economical to run. The model presents verification checks and reports predictions for a single discharge and for two interacting discharges. (Author's abstract)
W88-10229

BIOACCUMULATION OF COPPER AND ZINC BY NEREIS DIVERSICOLOR (ANNELIDA, POLYCHAETA) IN THE BOU REGREG ESTUARY (MOROCCO)(BIOACCUMULATION DU CUIVERE ET DU ZINC CHEZ NEREIS DIVERSICOLOER (ANNELIDE POLYCHETE) DE L'ESTURAIRE DU BOU REGREG (MAROC)),
Laboratoire de Zoologie et d'Ecologie Marine, Angers (France).
P. Gillet.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 3, p 339-350, 1987. 8 fig, 2 tab, 35 ref.

Descriptors: *Path of Pollutants, *Water pollution effects, Annelids, *Polychaetes, *Copper, *Zinc, *Bioaccumulation, Biomass, Estuaries, Ecology, Population exposue, Heavy metals, Mollusks, Crusteaceans, Morroco.

The physico-chemistry of the Bou Regreg estuary is described, and the variations of density and biomass of Nereid diversicolor are presented. The levels of copper and zinc vary seasonally and decrease from down stream to upstream for copper. These concentrations are less than values reported in mollusks or crustaceans. Such variations can explain the poor recruitment during autumn and affect the dynamics of this species. (Author's abstract)
W88-10249

EVALUATION OF THE RA226 TRANSPORT BY RIVER SEDIMENTS SURROUNDING THE BRAZILIAN URANIUM MINING AND MILLING FACILITIES,
Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Inst. de Radioproteccao e Dosimetria.
H. L. Azevedo, E. C. S. Amaral, and J. M. Godoy.
Environmental Pollution EPEBD7, Vol. 51, No. 4, 1988. 6 fig, 1 tab, 11 ref.

Descriptors: *Sediment transport, *Uranium, *Radium radioisotopes, *River beds, *Mine wastes, *Path of pollutants, Bottom sediments, Food chains, Radium, Pollution load.

A study of the Ra226 contamination of the river sediments surrounding the Brazilian uranium mining and milling facilities was carried out. The non-detrital Ra226 concentrations were determined performing a 0.5 normal HCl leaching. Some preliminary speciation experiments, using Tessier's sequential extraction procedure, were also carried out. Ra226 was used as a monitor of the natural variations. In general, one could not observe increases in the non-detrital Ra226 fraction between the pre-operational and operational data. Additionally, speciation experiments have shown the exchangeable fraction to be the main one responsible for Ra226 content. Although the results indicate that sediment is an important means of radium downstream transport, its availability suggests the soluble form to be the main path through the foodchain. Attention must be paid to the release of Ra226 bound to barium sulphate from the chemical processing effluent since increments of that fraction were observed in bottom sediments. (Author's abstract)
W88-10251

WATER QUALITY OF THE TWO MAARSSEVEEN LAKES IN RELATION TO THEIR HYDRODYNAMICS,
Water Board of Utrecht (Netherlands).
For primary bibliographic entry see Field 2H.
W88-10253

CADMIUM IN THE RHONE RIVER,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
L. Huynh-Ngoc, N. E. Whitehead, and B. Oregioni.
Water Research WATRAG, Vol. 22, No. 5, p 571-576, May 1988. 3 fig, 2 tab, 15 ref.

Descriptors: *Water pollution, *Cadmium, *Rhone River, *France, *Heavy metals, Stream pollution, Suspended solids, Water sampling, Spatial distribution, Chemical analysis, Fluvial sediments, Hydrogen ion concentration, Adsorption.

The distribution of cadmium in the Rhone River (France) was studied using differential pulse anodic stripping voltametry with a static mercury drop electrode. For 11 potentially contaminated river stations, the Cd in true solution averaged 39 ng/kg. Cd adsorbed on suspended matter was 19 ng/kg (liquid phase) and the suspended matter content was 2.4 mg/kg (solid phase), equivalent to 40, 22 and 38% respectively, of the total carried under these conditions. For sediments the mean Cd content was 0.9 mg/kg. The water values are low by world standards, even though sampling was biased towards sites potentially contaminated. This could be partially due to the unusual water pH of 7.8-8.5. (Author's abstract)
W88-10265

CONDITIONS REQUIRED FOR THE PRECIPITATION OF ALUMINIUM IN ACIDIC NATURAL WATERS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2K.
W88-10267

ORGANIC COMPLEXATION OF AL IN ACID WATERS: MODEL-TESTING BY TITRATION OF A STREAMWATER SAMPLE,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2K.
W88-10268

COMPLEXATION OF PROTONS, ALUMINUM AND CALCIUM BY AQUATIC HUMIC SUBSTANCES: A MODEL INCORPORATING BINDING-SITE HETEROGENEITY AND MACROIONIC EFFECTS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2K.
W88-10269

MECHANISMS OF PRECIPITATION OF MANGANESE(II) IN LAKE BIWA, A FRESH WATER LAKE,
Shiga Univ., Otsu (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W88-10270

ANTIBIOTIC RESISTANCE AMONG POLLUTION INDICATOR BACTERIA ISOLATED FROM AL-KHAIR RIVER, BAGHDAD,
Biological Research Center, Baghdad (Iraq).
M. R. Al-Ghazali, S. F. Jazrawi, and Z. A. Al-Doori.
Water Research WATRAG, Vol. 22, No. 5, p 641-644, May 1988. 3 fig, 2 tab, 17 ref.

Descriptors: *Path of pollutants, *Bioindicators, *Stream pollution, *Coliforms, *Bacteria, *Antibiotic resistance, Monitoring, Al-Khair River, Baghdad, Iraq.

The Al-Khair river stands as a narrow water course between two bends of the Tigris river near Baghdad (Iraq). Considerable deterioration of the water has occurred due to discharge of treated and untreated sewage as well as domestic wastes. Six sites along the river were allocated for monitoring water pollution. Escherichia coli was used as a pollution indicator. Strains of this bacterium were tested for their resistance to many antibiotics, multiplicity of resistance, and for the transferability of antibiotic resistance determinants. This study demonstrated that the Al-Khair river is heavily contaminated with antibiotic resistant E. coli, which proves a capability of spreading antibiotic resistance. Therefore, polluted surface waters affected by the discharge of domestic sewage may play some role in spreading antibiotic resistance among pollution indicators of the aquatic environment. (Author's abstract)
W88-10274

BIOCONCENTRATION AND METABOLISM OF BUTYLTIN COMPOUNDS IN CARP,
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
T. Tsuda, H. Nakanishi, S. Aoki, and J. Takebayashi.
Water Research WATRAG, Vol. 22, No. 5, p 647-651, May 1988. 7 fig, 1 tab, 18 ref.

Descriptors: *Path of pollutants, *Biological magnification, *Metabolism, *Carp, *Tin, *Butyltin compounds, Chemical properties, Partition coefficients, Muscle, Viscera, Liver, Kidneys, Fish physiology.

Bioconcentration factors (BCF) in carp (Cyprinus carpio Linne) and partition coefficients between n-octanol and water (P sub ow), were measured for bis(tri-n-butyl tin)oxide ((Bu3Sn)2O), di-n-butyl tin dichloride (Bu2SnCl2) and mono-n-butyl tin trichloride (BuSnCl3). Log P sub ow was 2.2 for (Bu3Sn)2O, 0.05 for Bu2SnCl2, and 0.09 for BuSnCl3 when n-octanol:water (volume ratio) = 1. The order of log BCF was kidney > gall bladder > liver > muscle for (Bu3Sn)2O; liver > gall bladder > kidney > muscle for Bu2SnCl2; and liver > or = gall bladder > kidney > muscle for BuSnCl3. On the other hand, the order of log BCF was (Bu3Sn)2O > BuSnCl3 > Bu2SnCl2 for muscle and viscera. (Bu3Sn)2O, metabolism in the carp was further studied. Bu2Sn(++) and BuSn(+++), metabolites of (Bu2Sn)2O, were detected in muscle and viscera. The concentration of BuSn(+++) greater than that of (Bu3Sn)2O in the liver and gall bladder after 10-14 days exposure. The ratio of (Bu3Sn)2O (as Bu2SnCl):Bu2Sn(++) (as Bu2SnCl2):BuSn(+++) (as BuSnCl3) concentrations in the metabolism of carp did not correspond to that of the BCF of carp for the ratio of (Bu3Sn)2O:Bu2SnCl2:BuSnCl3. (Author's abstract)
W88-10276

HEAVY METAL LOAD OF LAKE IIDESJARVI AS REFLECTED IN ITS SEDIMENTS,
Helsinki Univ. (Finland). Dept. of Geology.
P. Alhonen.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 11-16, 1987. 2 fig, 2 tab, 20 ref.

Descriptors: *Finland, *Lake Iidesjarvi, *Heavy metals, *Lake sediments, *Water pollution, *Paleolimnology, *Water pollution sources, *Path of pollutants, Fate of pollutants, Air pollution effects, Wastewater disposal, Lead, Mercury, Physical properties, Chemical properties, Lakes, Solute transport, Zinc, Copper, Cadmium, Hypertrophy.

Evidence of heavy metal pollution in the recent sediments of Iidesjarvi, a strongly polluted lake in the town of Tampere, is presented. The elevated levels of lead, mercury, zinc, copper and cadmium in the investigated core are associated with the influence of the urban and industrial environment on the limnological development of the lake. The physical, chemical and limnobiological properties show a hypertrophic level of the water. The effect and degree of the heavy metal pollution in Lake Iidesjarvi are based on the sedimentary anthropogenic enrichment factor values. They show that lead, mercury and cadmium are the most serious pollutants in the limnochemical cycle of the lake. The values for zinc and copper are clearly lower. Comparisons are made with the records from some other lakes in Finland and those of airborne pollutants in the town of Tampere. It seems that the major sources of heavy metal load in Lake Iidesjarvi are associated with sewage discharge and atmospheric pollution on a local and long-transport scale. (Author's abstract)
W88-10287

PCB IN THE SEDIMENTS OF THE LAKE JYVASJARVI,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
J. Paasivirta, K. Mantykoski, R. Paukku, T. Piilola, and H. Vihonen.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 17-23, 1987. 2 fig, 3 tab, 14 ref.

Descriptors: *Polychlorinated biphenyls, *Finland, *Lake Jyvasjarvi, *Lake sediments, *Path of pollutants, *Paleolimnology, *Water pollution sources, *Fate of pollutants, Lakes, Municipal wastewater, Water pollution, Air pollution, Industrial wastewater, Precipitation, Phosphorus load, Lakes.

To investigate the observed exceptional increase of polychlorinated biphenyls (PCB) in fish of the Northern Paijanne, Finland, PCB contents in sediments of Lake Jyvasjarvi, a small lake draining to Paijanne, were measured at three areas down to 21-25 cm layer. Analysis methods included remov-

al of sulfur. Dating of the sediment was based on phosphorus load data. High PCB contents were found in the western and central part of the Lake in layers from 1954-74 showing clear maxima at 1969-70. Since 1974, the levels of PCB have been low at all three areas. The results can be explained by assuming that a major part (95 kg) of the PCBs sedimented during the period 1968-83 was from communal and industrial wastewaters and another part (23 kg) as precipitation of evenly distributed airborne particles. (Author's abstract)
W88-10288

USE OF VERTICAL SNOW SAMPLING AS AN INDICATOR OF SOME EMISSIONS FROM POINT SOURCES,
Insinoori- ja Limnologitoimisto Oy Vesitekniikka A.B., Salpakangas (Finland).
For primary bibliographic entry see Field 5A.
W88-10296

AQUATIC MACROPHYTES IN THE SEA AREA AROUND THE LOVIISA NUCLEAR POWER STATION, SOUTH COAST OF FINLAND,
Finnish Centre for Radiation and Nuclear Safety, Helsinki.
For primary bibliographic entry see Field 5C.
W88-10297

SNOW COVER AND MAXIMUM LEACHATE DISCHARGE OF A SANITARY LANDFILL,
Insinoori- ja Limnologitoimisto Oy Vesitekniikka A.B., Salpakangas (Finland).
M. Ettala.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 187-202, 1987. 12 fig, 15 tab, 27 ref.

Descriptors: *Snow cover, *Water pollution control, *Water pollution prevention, *Path of pollutants, *Water pollution sources, *Leachates, *Sanitary landfills, Runoff, Basins, Snowmelt, Fate of pollutants, Temperature effects, Wastewater treatment, Seasonal variation, Design criteria, Pollution load, Finland.

The scale and importance of the maximum discharge was studied in 1985 at six sanitary landfills in southern Finland. Attention was paid to the water equivalent and the quality of the snow cover on the landfills, the temperature of the refuse and the leachate discharge. The quality of the snow cover on the landfills was similar to that found in urban areas, but the quality of the leachate was much poorer than that of the snow cover. Although the weather during the study was exceptionally cold, up to 30% of the landfill area was free of snow due to dumping of waste and the high temperature of the refuse. The water equivalent at the landfills was smaller than in their surroundings. There was no leachate discharge in the winter. The maximum runoff and the pollutant load on the receiving waters and the wastewater treatment plant were the greatest in spring. The annual leachate volume and maximum spring runoff were smaller than in the small drainage basin. The simplest way of controlling the maximum runoff is to build a leachate basin. The dimensions of the basin have to be determined for each landfill separately, because significant variation occurs not only in the leachate treatment method and the acceptable discharge but also in the age, size, use, slope, density, state of decomposition, drainage system, cover material, vegetation and location of the landfill. The spring runoff at the 5% probability level, generally used in Finland for determining the basin dimensions, resulted in overestimation. It is possible and economically profitable to diminish the basin volume and the pollutant load on the receiving waters by moving the undisturbed snow cover on the landfill to the other side of the surrounding ditches. The 50% probability of excess for total spring runoff can then be used as the basis for determining the dimensions of the leachate basin. To estimate the scale and importance of the maximum spring runoff and the total pollutant load on the receiving waters, measurements of the leachate discharge from sanitary landfills should be carried out much more often than twice or four times a year. In addition, attention should be paid to the reading accuracy of the V-notch weir. (Author's abstract)
W88-10304

SURVEY OF ACIDIFICATION BY AIRBORNE POLLUTANTS IN 52 LAKES IN SOUTHERN FINLAND,
Finnish Forest Research Inst., Helsinki. Dept. of Peatland Forestry.
A. Patila.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 203-210, 1987. 2 fig, 4 tab, 27 ref, append.

Descriptors: *Oligotrophic lakes, *Finland, *Acidic water, *Path of pollutants, *Watersheds, *Acid rain, *Aluminum, *Fate of pollutants, *Hydrogen ion concentration, Lakes, Clays, Buffering, Color, Air pollution, Water pollution sources.

The effects of the airborne acidifying load on the water chemistry were studied in 52 oligotrophic lakes in southernmost Finland. Earlier data had shown that the acidification of some of the lakes occurred as early as the 1960's. The median pH of the 52 lakes was 5.3 and the mean alkalinity was 0.04 mmol/l (1-meter samples). The mean total aluminum concentration was 133 microg/l and Al values exceeding 200 microg/l were found in 11 lakes. When the lakes were grouped according to their pH and color value, the strongest negative correlation between pH and total Al was found in the most acid group ($pH < or = 5.0$) of the clear water lakes, which indicates that the aluminum was probably mainly inorganic Al(+3). Study of the watershed characteristics revealed that clay soils, in particular, caused a considerable increase in the buffering capacity of the lakes. (Author's abstract)
W88-10305

SENSITIVITY OF SURFACE WATERS TO ACIDIC DEPOSITION IN FINLAND,
National Board of Waters, Helsinki (Finland).
J. Kamari.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 211-219, 1987. 6 fig, 1 tab, 20 ref.

Descriptors: *Surface water, *Finland, *Acid rain, *Model studies, *Acidic water, *Maps, Prediction, Catchment areas, Correlation analysis, Path of pollutants, Air pollution, Hydrogen ion concentration, Model studies, Water pollution, Computer models.

The main objective of determining regional sensitivities to surface water acidification has been to identify geographical areas in which fresh waters vulnerable to acid deposition may exist. In relation to this goal, sensitivity to acidification can be defined as indicating the relative probability of impacts of acidic deposition on freshwater ecosystems occurring in the region. A method incorporating available regional data was applied to evaluate the sensitivity of different regions to surface water acidification in Finland. The method uses information on rock types, soil properties, runoff and terrestrial relief. All the data were stored in a computerized grid based format. As a result, a map of Finland was produced that indicates the relative sensitivities of surface waters to acidic depositionin each grid square. When comparing this map with a map showing the spatial distribution of acidic clear water lakes, it is observed that, in areas with higher deposition, the lakes with low pH are mainly located in the most sensitive areas. Large areas of northern Finland are also rated as sensitive by the sensitivity map, but evidently deposition has been so low that impacts have not been determined. (Author's abstract)
W88-10306

STUDYING THE PHOSPHORUS RELEASE FROM THE LOOSDRECHT LAKES SEDIMENTS, USING A CONTINUOUS FLOW SYSTEM,
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 2H.
W88-10346

SURFACE RUN-OFF POLLUTION OF AGRICULTURAL BASINS IN THE PROTECTIVE ZONE OF THE DOBCZYCE DAM RESERVOIR (THE CARPATHIAN PLATEAU--POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
K. Stachowicz.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 21-42, 1986. 6 fig, 5 tab, 29 ref.

Descriptors: *Reservoirs, *Agricultural watersheds, *Agricultural runoff, *Poland, *Water pollution sources, Water pollution effects, Runoff, Water quality, Erosion, Basins, Surface runoff, *Dams, Land use, Regression analysis, Correlation analysis, Catchment areas.

A three-year study was undertaken to determine the influence of surface runoff from the agricultural basin of the Wolnica stream and the forest-agricultural basin of the Brzezowka stream. The two catchment areas lie in the protective zone of a dam reservoir currently under construction in the Carpathian Plateau of Poland. It was shown that land use in the basin and the intensity of surface water erosion associated with it are the main factors in surface runoff pollution in submontane catchment areas (300-470 m). Higher concentrations and loads of suspension, N-NH4, organic N, total P, P-PO4, and BOD5 were found in the stream draining the agricultural basin. Regression and correlation analysis showed an increase in concentration of these factors with increased outflow. The export of phosphorus was reduced to one third in the forest-agricultural basin. The characteristic use of small fields did not limit the loss of nutrients. It is concluded that the control of surface runoff pollution in the basins is essential to prevent eutrophication, sliming of the dam reservoir, and further soil degradation in the basins. (See also W88-10363) (Doria-PTT)
W88-10362

SURFACE RUN-OFF POLLUTION DURING THAWS AND HEAVY RAINFALL IN AGRICULTURAL CATCHMENT BASINS (THE CARPATHIAN PLATEAU, POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
K. Stachowicz.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 43-54, 1986. 3 fig, 2 tab, 14 ref.

Descriptors: *Surface runoff, *Water pollution sources, *Agricultural *watersheds, *Agricultural runoff, *Erosion, Runoff, Water pollution, Land use, Nutrients, Suspension, Solute transport, Seasonal variation, Poland.

The effect of surface runoff pollution in periods of spring and winter thaw and after heavy rainfall was investigated in two submontane catchment basins in the Carpathian Plateau, Poland. It was found that the amount of suspension flowing from the stream during a 24 hour period can be decisive for its annual load. When soil participated in the process of forming surface runoff pollution (spring thaw, heavy rainfall), the configuration of the terrain determined the concentrations of suspended and nutritive matter. Conversely, when the role of the soil was limited (winter thaw), land use became the factor affecting the concentration and pollution loads. Overall, land use in the basin was a key factor while water retention played an intermediate role. (Author's abstract)
W88-10363

CHEMICAL COMPOSITION OF THE WATER IN THE RIVER MALA PANEW, AND ITS TRIBUTARIES, AND OF THE GROUND WATER IN ITS BASIN IN THE UPPER SILESIAN INDUSTRIAL REGION (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Bombowna.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 55-67, 1986. 3 fig, 1 tab, 25 ref.

Descriptors: *Chemical composition, *Groundwater pollution, *Path of pollutant, *River basins, *Industrial development, *Poland, *Eutrophication, *Catchment areas, *Rivers, Water pollution, Tributaries, Trophic level, Nutrients, Dams, Reservoirs, Water pollution effects, Mine drainage, Domestic wastes, Wastewater, Saline water.

Hydrobiological investigations were carried out in the upper sector of the River Mala Panew and its tributaries to determine the extent of pollution. Samples were collected at five stations from May 1976 to May 1979 at 2-3 month intervals. Groundwater was also sampled at one station. Analyses were conducted for cations and anions, electrical conductivity, nutrients, and organic matter. It was found that the water chemistry was influenced by industrial pollution, the forestation of the drainage basin, and its agricultural utilization. The last factor was especially evident in the groundwater. The river is significantly loaded with non-biodegradable pulp mill waste. Industrial waste containing heavy metals, domestic sewage, and saline mine waters creates a toxic environment and extends the self-purification zone of the River Stola (a tributary). This mixture of wastes mingles with surface and runoff groundwater contributing to eutrophication. The increase in organic matter in the middle and lower course of the Mala Panew threatens a reservoir located in the lower part of the river. It is concluded that environmental protection regulations should be enforced in this region. (Doria-PTT)
W88-10364

GROUND INFLOW OF NUTRIENTS FROM CATCHMENT AREAS INTO TWO LAKES OF THE LECZYNSKO-WLODAWSKIE LAKE DISTRICT OVER A PERIOD OF THREE YEARS,
Akademia Rolnicza, Lublin (Poland). Inst. of Soil Science and Agricultural Chemistry.
H. Smal.
Acta Hydrobiologica (Cracow) (AHBPAX), Vol. 28, No. 1/2, p 69-81, 1986. 1 fig, 6 tab, 23 ref.

Descriptors: *Nutrients, *Lakes, *Surface runoff, *Groundwater movement, *Groundwater pollution, *Nonpoint pollution sources, *Path of pollutants, *River basins, *Industrial development, *Path of pollutants, *Water pollution sources, Groundwater, Poland, Chemical composition, Water pollution, Watersheds, Catchment areas, Agricultural watersheds, Wastes, Recreation wastes, Recreation, Tourism.

The effect of land use on the chemical composition of groundwater was studied in sectors of catchment areas of two Mesotrophic lakes in Poland. The ground runoff to the lakes was calculated on the basis of the amount of groundwater inflow from the particular sectors and on the concentration of elements during periods of water runoff. For the catchment area of Lake Piaseczno, it was found that nutrients were more abundant in groundwaters of agricultural areas compared to forest and peat bog sectors. In the catchment area of Lake Bialka, the most fertile waters were found in the forest sector with dense recreational building development. The richest source of nutrients for Lake Piaseczno was the agricultural territories. The subsoil runoff was also higher from the agricultural sector. In the catchment area of Lake Bialka, the meadow-arable forest areas supplied the greatest amount of nutrients to the lake, although the forest areas, from which flow the largest quantity of nutrients ha per year, may be a greater threat. It is concluded that, where soil is naturally of low fertility, improper agricultural management and badly organized tourism and recreation are a pollution threat to shallow groundwater and surface waters recharged by them. (Author's abstract)
W88-10365

EFFECT OF THE GOCZALKOWICE DAM RESERVOIR ON THE HYDROCHEMICAL CONDITIONS OF THE RIVER VISTULA BELOW THE DAM (SOUTHERN POLAND),
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
H. Kasza.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 83-97, 1986. 7 fig, 1 tab, 22 ref.

Descriptors: *Water quality, *Reservoirs, *Dam effects, *Water pollution sources, *Nitrogen, *Phosphorus, *Organic matter, Dams, Oxygen, Rivers, Hydraulic structures, Poland, Path of pollutants, Water pollution, Chemical composition, Vistula River, Ammonium.

The effect of the Goczalkowice reservoir on the physicochemical properties of the waters of the River Vistula (Southern Poland) were investigated at four stations in 1982-1983: above the inflow to the reservoir, directly below the dam, and 1 km and 20 km below the reservoir. When compared with the entering waters, those flowing out from the reservoir are poorer in mineral compounds of nitrogen and phosphorus but richer in organic matter. In summer, the waters below the reservoir contain far less oxygen than those flowing in. It is concluded that the reservoir has a negative effect on the purity of the River Vistula. (Author's abstract)
W88-10366

INDICES OF BACTERIOLOGICAL AND CHEMICAL QUALITY OF WATERS IN THE UPPER SILESIAN INDUSTRIAL REGION (SOUTHERN POLAND) AFFECTED BY ATMOSPHERIC POLLUTION AND INDUSTRIAL WASTES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Starzecka.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 99-110, 1986. 4 fig, 1 tab, 27 ref.
Project No. MR.II.15.

Descriptors: *Water pollution sources, *Air pollution, *Industrial wastes, *Bacterial analysis, *Water quality, Wastes, Chemical analysis, Water analysis, Chemical properties, Physical properties, Heavy metals, Stream Biota, Poland, Industrial development, Bioindicators, Bacteria, Aquatic bacteria, Pulp and paper industry, Comparison studies.

Bacteriological investigations of waters in the Upper Silesian Industrial Region (Southern Poland) were carried out in 1976-1979 in order to compare the water quality of the River Mala Panew basin (polluted by industrial wastes) with that of the River Brynica basin (polluted by atmospheric dusts). Factors determined included total numbers of heterotrophic bacteria and numbers of proteolytic bacteria using the plate method, and the titre of bacteria taking part in nitrogen and sulfur transformation. Water in the River Brynica was found to be relatively pure, while the Mala Panew was strongly polluted by the inflow of wastes from plants in the Upper Silesian Industrial Region. The strongest pollution was found at Brusiek, below the discharge of wastes from a paper factory. It was manifested by a rich development of bacterial microflora with differentiated biochemical abilities, probably due to the high organic matter content observed in the entire basin. Dissolved oxygen was low, and ammonia and BOD5 were high. Heavy metal concentrations from the industrial effluent discharged into the Mala Panew far exceeded concentrations in atmospheric dust deposited in the River Brynica basin. (Author's abstract)
W88-10367

MICROBIOLOGICAL CHARACTERISTICS OF THE RIVER DUNAJEC WATERS IN THE SECTOR BETWEEN NOWY TARG AND NOWY SACZ (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
G. Mazurkiewicz.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 111-119, 1986. 3 fig, 26 ref.

Descriptors: *Stream Biota, *Eutrophication, *Rivers, *Aquatic bacteria, *Water pollution sources, Biomass, Biological properties, Density, Population density, Bacteria, Heterotrophic bacteria, Wastes, Microbiological studies, Bacterial analysis, Domestic wastes, Wastewater, Poland, Water pollution, Reservoirs.

The microbiological characteristics of the River Dunajec were investigated in the sector from Nowy Targ to Nowy Sacz (Southern Poland). The description is based on the analysis of numbers of selected groups of bacteria whose growth and development in surface waters are limited by the concentration of easily accessible nutrients, oxygen concentration, and temperature. Total heterotrophs varied from 140 to 140,000 cells/ml. Proteolytic bacteria were less abundant by about one order of magnitude. Ammonifying bacteria were the most abundant. Greatest bacterial biomass was observed in the summer. Average bacterial numbers and biomass were found downstream of towns and decreased further away from towns. Results show the rapid degradation of the Dunajec waters. The highest level of eutrophication is noted below Nowy Targ and Nowy Sacz. (Author's abstract)
W88-10368

FORMS OF MINERAL PHOSPHORUS IN THE BOTTOM SEDIMENTS OF THE LUBACHOW RESERVOIR AND LAKE SLAWA (SOUTHWESTERN POLAND),
Wyzsza Szkola Inzynierska, Zielona Gora (Poland).
For primary bibliographic entry see Field 2H.
W88-10373

TRANSPORT OF HEAVY METALS IN THREE DIFFERENTLY POLLUTED SURFACE WATERS IN SILESIA (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 3/4, p 279-291, 1986. 1 fig, 4 tab, 31 ref.

Descriptors: *Heavy metals, *Solute transport, *Path of pollutants, *Water pollution, Poland, Lead, Copper, Nickel, Cadmium, Cobalt, Zinc, Manganese, Iron, Chemical reactions, Wastes, Industrial wastes, Chemical wastes, Pulp wastes, Domestic wastes, Chemical properties, Silesia, Adsorption, Complexation, Precipitation, Hydrogen ion concentration.

The transport of Pb, Cu, Ni, Cd, Co, Zn, Mn, and Fe was investigated in waters in Silesia (Southern Poland) polluted by metallurgical, chemical, municipal, and pulp-mill wastes. The effect of Fe-Mn oxides, Ca and Mg carbonates, chlorides, sulfates, nitrates, phosphates, and organic matter on the transport of metals was analyzed on the basis of linear correlations of the bulk concentrations of metals and chemical parameters of the water. The relative importance of the different chemical mechanisms is discussed in relation to the quality and the level of water pollution, physico-chemical conditions, and chemical interactions of various types. It is concluded that the type of chemical mechanism controlling heavy metal transport in different rivers depends on environmental conditions. Depending on such factors as pH or the concentration of chemical components, interactions such as stabilization or destabilization, competition, complexation, sorption, or coprecipitation, modify the chemical equilibrium in the complicated multimetal-multiligand system of the water environment. (Author's abstract)
W88-10374

HYDROCHEMICAL CHARACTERISTICS OF THE WISLA-CZARNE RESERVOIR (SOUTHERN POLAND) IN THE PERIOD 1975-1984,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
H. Kasza.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 3/4, p 293-306, 1986. 9 fig, 4 tab, 14 ref.

Descriptors: *Pollution load, *Water pollution sources, *Path of pollutants, *Reservoirs, *Nutrients, *Trophic level, Poland, Flood control, Physical properties, Chlorophyll a, Chemical composition, Chemical properties, Nitrogen, Oxygen, Water pollution, Eutrophication, Phosphorus, Limnology, Transparency, Optical properties, Lakes, Mesotrophic lakes.

The hydrochemical characteristics of the Wisla-Czarne reservoir and its affluents are described. The intake of the biogenous compounds of the reservoir and the loading of the bottom nutrients were calculated. Changes in some of the physico-chemical features of the reservoir water during the period of investigation (1976-1984) of the reservoir water are given on the basis of their annual means. The critical loading with phosphorus, which endangers the purity of the reservoir, may amount to 0.52 P total mg/sq m of the reservoir area. The estimated inflow of phosphorus to the reservoir after taking into account water exchange is twice as low. This suggests that the development of phytoplankton should be small. Investigations of chlorophyll a content supports this conclusion. A comparison of the average content of chlorophyll a (4.5 micrograms/cu dm), and the transparency values (3.3 m) are in conformity with values previously reported elsewhere for mesotrophic waters. (Author's abstract)
W88-10375

VERTICAL DISTRIBUTION OF CERTAIN ORGANOCHLORINE COMPOUNDS IN THE MONOMICTIC LAKE ZONAR (CORDOBA, SPAIN),
Cordoba Univ. (Spain). Dept. de Ecologia.
A. Lopez Fernandez, and T. Munoz Albelda.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 3/4, p 307-316, 1986. 3 fig, 2 tab, 16 ref.

Descriptors: *Pesticides, *Chlorinated hydrocarbons, *Vertical distribution, *Monomictic lakes, *Path of pollutants, Halogenated pesticides, Insecticides, Hydrocarbons, Distribution, Water depth, Stratification, Water pollution, Sediments, Physical properties, Lake Zonar, Chemical stratification, Temperature, Oxygen, Dissolved oxygen, Sedimentation, Spain.

The depth variations of organochlorine insecticide residue levels in the waters of Lake Zonar (Cordoba, Spain) were studied. During the stratification period, an exponential increase in contaminant rates was recorded in relation to depth, this correlation disappearing in the mixing period. The recorded pollution was due mainly to hexachlorocyclohexanes with a mean level of 0.48 ppb in the mixing period, 0.43 ppb in the epilimnion, 0.80 ppb in the thermocline, and 3.62 ppb in the hypolimnion during the stratification period. The highest levels were found in sediments (20.15 ppm dry weight). (Author's abstract)
W88-10376

LABORATORY STUDIES IN THE EFFECT OF DIFFERENT CONDITIONS OF OXYGENATION ON THE BIOSESTON OF THE UPPER VISTULA (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Schmager.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 3/4, p 329-343, 1986. 7 fig, 2 tab, 22 ref.

Descriptors: *Seston, *Oxygenation, *Rivers, *Self-purification, *Algae, *Bacteria, Poland, Ecology, Density, Population density, Aquatic bacteria, Zoogloea, Diatoms, Chlorophyta, Chemical properties, Vistula River, Cyanophyta.

The effect of an exponentially increasing degree of oxygen saturation of the water on the course of self-purification processes and on the bioseston of the polluted water of the upper Vistula (Southern Poland) was studied. It was demonstrated that aeration brought about a decline in the numbers of small filamentous bacteria, with a simultaneous increase in the area and number of Zoogloea associations and an increase in the number of algae. Results indicate that each of the algal species has an oxygen optimum within which, under conditions of natural competition, it achieves its maximum numbers. For example, numbers of Microcystis increased with increasing oxygen saturation up to a level of about 70% to 80%, after which it began to decline. It is concluded that an improvement in oxygenation of the upper reaches of the Vistula would contribute to a change in the composition of its bioseston. (Author's abstract)
W88-10378

LANDSPREADING DIOXIN-CONTAMINATED PAPERMILL SLUDGE: A COMPLEX PROBLEM,
Wisconsin Dept. of Health and Social Services, Madison. Bureau of Community Health and Prevention.
For primary bibliographic entry see Field 5E.
W88-10391

EVOLUTION OF THE CHEMICAL COMPOSITION OF THE GARONNE RIVER WATER DURING THE PERIOD 1971-1984,
Toulouse-3 Univ. (France). Lab. de Mineralogie et Cristallographie.
D. Etchanchu, and J. L. Probst.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 3, p 243-256, June 1988. 4 fig, 3 tab, 22 ref.

Descriptors: *Garonne River, *Water quality, *France, *Rivers, Nitrates, Sulfates, Chlorides, Potassium, Calcium, Chemical composition, *Chemical properties, Magnesium, Bicarbonates, Hydrogen ion concentration, Organic matter, Oxidation, Chemical reactions, Fertilizers, Water pollution sources, Water pollution, Low flow.

The evolution of the chemical composition of the Garonne River water (southwestern France) was studied for the period 1971-1984. Long-term trends were detected and quantified for all the major elements using concentration-time relationships. An increasing concentration was observed for most of the elements, while pH exhibited a small decrease. The large increases of nitrate, sulfate, chloride, and potassium ions in the river water are related to a marked increase in fertilizer applications. Calcium, magnesium, and bicarbonate increases are not so evident. The coefficient of calcite saturation is too low to explain this change, but rather it can be attributed to an increase in carbonate dissolution resulting from the nitrification of N fertilizers in the basin. A decrease in pH, more particularly during low flows, is attributed to oxidation of organic matter which is reflected by an increase in COD. (Author's abstract)
W88-10399

SIMULATION OF BIODEGRADATION AND SORPTION PROCESSES IN GROUND WATER,
GeoTrans, Inc., Herndon, VA.
P. Srinivasan, and J. W. Mercer.
Groundwater GRWAAR, Vol. 26, No. 4, p 475-487, July-August, 1988. 7 fig, 2 tab, 40 ref, append.

Descriptors: *Biodegradation, *Sorption, *Simulation analysis, *Path of pollutants, *Fate of pollutants, *Groundwater pollution, Mathematical models, Groundwater, Finite difference methods, Groundwater pollution, Isotherms, Fate of pollutants, Hydrocarbons, Mathematical analysis, Boundary conditions, Aquifer characteristics.

A one-dimensional, finite-difference model for simulating biodegradation and sorption processes in saturated porous media is developed. The model formulation is general and capable of accommodating a variety of boundary conditions and process theories. Advective and dispersive transport of a substrate and an electron acceptor are considered. Aerobic biodegradation is modeled using a modified Monod function; anaerobic biodegradation is modeled using Michaelis-Menten kinetics. In addition, first-order degradation is allowed for both substances. Sorption can be incorporated using linear, Freundlich, or Langmuir equilibrium isotherms for either substance. Dirichlet, Neumann, or Cauchy boundary conditions are allowed, where they are constant in time, or include first-order degradation. The resulting nonlinear problem is solved using a Newton-Raphson iterative technique. Model verification is achieved through a series of simulations, two of which are included. In addition, three applications demonstrated the utility of the model. (Author's abstract)
W88-10421

SEDIMENT, PHOSPHORUS, AND NITROGEN IN CHANNELISED SURFACE RUN-OFF FROM A NEW ZEALAND PASTORAL CATCHMENT,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
C. M. Smith.
New Zealand Journal of Marine and Freshwater Research, Vol. 21, No. 4, p 627-639, 1987. 8 fig, 5 tab, 23 ref.

Descriptors: *Agricultural runoff, *Phosphorus, *Soil erosion, *Nonpoint pollution sources, *Nitrogen, *Surface runoff, *Pastures, Channels, Sheep, Catchment areas, Chemical analysis, Slopes, Runoff rates, Water pollution sources, New Zealand.

Surface run-off derived from 94 m (20 degree) and 230 m (15 degree) long hillslopes in a pastoral catchment was collected along a 15.8 m total intercepting face between July 1, 1983 and March 31, 1985; run-off subsamples were analyzed chemically. Surface run-off occurred on 49 occasions, these 'events' ranging from 0.2 to 155 cu m. About 50% of the total run-off occurred in six events. In 20 months the eight individual 1.5-2.4 m long collectors intercepted 4-333 cu m of water. This uneven spatial run-off pattern, the measured flow rates, and total event volumes indicated that extensive areas on both hillslopes produced run-off, and that extreme channelization occurred during movement downslope. Mean flow weighted run-off concentrations were for total phosphorus (TP) 1053 mg/cu m, total dissolved phosphorus (TDP) 300 mg/cu m, Kjeldahl nitrogen (TKN) 5898 mg/cu m, dissolved Kjeldahl nitrogen (DKN) 1413 mg/cu m, NO3-N 69 mg/cu m, suspended sediments (SS) 472 g/cu m, and volatile suspended sediment (VSS) 115 g/cu m. Estimated catchment surface run-off yields in 1984 were: TP 0.75 kg/ha, TDP 0.15 kg/ha, TKN 4.43 kg/ha, DKN 0.74 kg/ha, NO3-N 0.03 kg/ha, SS 374 kg/ha, and VSS 90 kg/ha. Virtually all phosphorus and nitrogen was transported downslope in winter and spring. Controlling these run-off nutrient inputs to the catchment stream is briefly discussed. (Author's abstract)
W88-10441

RELATION BETWEEN HUMAN PRESENCE AND OCCURRENCE OF GIARDIA CYSTS IN STREAMS IN THE SIERRA NEVADA, CALIFORNIA,
Geological Survey, Sacramento, CA.
T. J. Suk, S. K. Sorenson, and P. D. Dileanis.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 71-75, June 1987. 1 fig, 13 ref.

Descriptors: *Human diseases, *Stream pollution, *Public health, *Water pollution sources, *Cysts, *Giardia cysts, *Recreation wastes, Downstream, Filtration, Parasites, Species distribution, Path of pollutants, Sierra Nevada, California.

To study the origin and distribution of Giardia cysts, a portable apparatus was used to filter large quantities of water from streams in California's Sierra Nevada. The sample apparatus consisted of a 12-V submersible bilge pump, filter housing with a fiber/epoxy filter, flow meter, and 12-V gell cell battery. For most samples, at least 378 liters of stream water was filtered. Samples were processed and examined for Giardia spp. Cysts of Giardia were detected in 22 of 49 (44.9 percent) samples collected at sites downstream from areas of high recreational use and in 5 of 29 (17.2 percent) samples collected at sites downstream from areas of low recreational use. Eliminating duplicate sampling at several sites, 40.9 percent of high-use sites and 20.0 percent of low-use sites were positive for Giardia. The number of cysts detected ranged from 1 to 41. These data indicate that intensity of human use may play a significant role or be a useful indicator in Giardia contamination of surface water. (Author's abstract)
W88-10453

BUDGET AND INPUT-OUTPUT MODEL FOR TOTAL PHOSPHORUS IN LAKE LEMAN

(BILAN ET MODELE D'ENTREES - SORTIES DU PHOSPHORE TOTAL DANS LE LEMAN),
Geneva Univ. (Switzerland). Unite de Biologie Aquatique.
J. M. Jaquet.
Annales de Limnologie ANLIB3, Vol. 21, No. 3, p 177-189, 1985. 8 fig, 5 tab, 20 ref.

Descriptors: *Limnology, *Phosphorus, *Eutrophication, *Model studies, *Lake Leman, *Cycling nutrients, Water pollution control, Variability, France, Switzerland, Lakes, Sediment transport, Chemical analysis, Detergents, Loading rate.

A total phosphorus input-output budget for Lake Leman is presented and discussed for a 20-year period, during which a net elimination predominates at a phi rate of 0.20/yr. This coefficient, however, greatly varies from year to year, net sedimentation or net regeneration occurring as a function of meterological conditions (winter temperature and river discharge). The application of Vollenweider's model and OECD norms is discussed. It is shown that an approximation of phi by flushing rate alone would grossly overestimate true elimination. To allow for phi variability, the phosphorus stock evolution is stochastically simulated according to several schemes of variation in loading. It is shown that a realistic variability of phi (50%) may induce interannual stock fluctuations of several thousand tons. Under the present loading conditions (1200 t/yr), and even after a 400 t reduction stemming from a ban on detergent phosphate, the lake will not reach the target stock of 2000-3000 t. (Author's abstract)
W88-10468

GEOCHEMISTRY OF THE RHINE AND THE RHONE. 5: SYNTHESIS AND CONCLUSIONS (GEOCHIMIE DU RHIN ET DU RHONE. 5: SYNTHESE ET CONCLUSIONS),
Station Biologique de la Tour du Valat, Arles (France).
For primary bibliographic entry see Field 5A.
W88-10469

ELECTRIC LOG INTERPRETATION FOR THE EVALUATION OF SALT WATER INTRUSION IN THE EASTERN NIGER DELTA,
Ilorin Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W88-10484

EXPERIMENTAL STUDY OF MERCURY TRANSFER BETWEEN ARTIFICIALLY CONTAMINATED SEDIMENT (CH3HGCL) AND MACROPHYTES (ELODEA DENSA),
Bordeaux-1 Univ., Talence (France). Lab. d'Ecologie Fondamentale et d'Ecotoxicologie.
R. Maury, A. Boudou, F. Ribeyre, and P. Engrand.
Aquatic Toxicology AQTODG, Vol. 12, No. 3, p 213-228, March 1988. 6 fig, 1 tab, 23 ref.

Descriptors: *Aquatic soils, *Mercury, *Path of pollutants, *Macrophytes, *Elodea, *Methylmercury, *Sediment-Water interfaces, *Bioaccumulation, Water pollution, Water pollution effects, Heavy metals, Experimental ecosystems, Freshwater, Sediments, Accumulation, Absorption.

The quantification of metal transfer routes from a natural sediment enriched with methylmercury (4 mg Hg per kg fresh weight) to Elodea densa, shows a high mercury accumulation in the plant organs (leaves, stems and roots). The experimental approach developed shows that, in the long term (28 days), root absorption of the organic compound (direct route) represents the dominating vector of metal accumulation in the plant, the leaves being the principal organ for storage. Two mechanisms, far less important from a quantitative point of view, are superimposed in this direct transfer: (1) contamination by the water linked to the releasing phenomenon at the water-sediment interface during the initial exposure phase, and (2) inter-plant transfers, resulting from decontamination processes, acting together with direct metal accumulation in the E. densa. (Author's abstract)
W88-10504

RELATIONSHIPS BETWEEN SUBCELLULAR DISTRIBUTIONS OF CADMIUM AND PERTURBATIONS IN REPRODUCTION IN THE POLYCHAETE NEANTHES ARENACEODENTATA,
California State Univ., Long Beach. Molecular Ecology Inst.
For primary bibliographic entry see Field 5C.
W88-10505

TOXICOKINETICS OF ORGANIC XENOBIOTICS IN THE AMPHIPOD, PONTOPOREIA HOYI: THE ROLE OF PHYSIOLOGICAL AND ENVIRONMENTAL VARIABLES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W88-10506

LEVELS OF IRON, ALUMINUM, ZINC, CADMIUM AND MERCURY IN PLANTS GROWING IN THE SURROUNDINGS OF AN ACIDIFIED AND NON-ACIDIFIED LAKE IN ESPOO, FINLAND,
Helsinki Univ. (Finland). Dept. of Environmental Science.
P. Nuorteva, S. Autio, J. Lehtonen, A. Lepisto, and S. Ojala.
Annales Botanici Fennici ABOFAQ, Vol. 23, No. 4, p 333-340, 1986. 2 fig, 6 tab, 62 ref.

Descriptors: *Acid rain effects, *Lakes, Acidity, *Heavy metals, *Aluminum, *Acidic water, Iron, Cadmium, Mercury, Comparison studies, Finland, Atomic absorption analyses, Catchment areas, Forest die-off, Plants, Bioindicators.

Atomic absorption analyses were performed on plants growing in the catchment areas of an acidified lake (Hauklampi) and a non-acidified lake (Kurkijarvi) lying near each other in an uncultivated, uninhabited area in Espoo, S. Finland. The material was comprised of 14 fungi, 7 lichens, 11 musci, 5 pteridophyta, 2 gymnospermae and 25 angiospermae. In spruce and pine, the contents of the metals other than zinc were 2-3 times as high as the roughly natural levels measured in Lapland. The contents of mercury in the plants did not differ between the two study areas, but aluminum, zinc and cadmium clearly tended to have higher contents in the more acidic surroundings of Lake Hauklampi and iron in the surroundings of the nonacidified Lake Kurkijarvi. Many Rosaceae showed higher cadmium contents in the more alkaline catchment area of Kurkijarvi. Plants that appeared to be specially sensitive indicators were the rock moss Ceratodan purpureus for iron, the fungus Rozites caperata for cadmium and possible Anemone nemorosa for the springtime movements of aluminum. (Author's abstract)
W88-10511

GEOCHEMICAL MASS-BALANCE RELATIONSHIPS FOR SELECTED IONS IN PRECIPITATION AND STREAM WATER, CATOCTIN MOUNTAINS, MARYLAND,
Geological Survey, Towson, MD.
B. G. Katz, O. P. Bricker, and M. M. Kennedy.
American Journal of Science AJSCAP, Vol. 285, No. 10, p 931-962, December 1985. 10 fig, 4 tab, 53 ref.

Descriptors: *Chemistry of precipitation, *Acid rain, *Weathering, *Geochemistry, Ions, Precipitation, Stream water, Deposition, Chemical composition, Watersheds, Sodium concentration, Chloride concentration, Mass balance, Catoctin Mountains, Hydrogen, Sulfate, Calcium, Nitrate, Magnesium, Bicarbonate, Maryland.

During 1982 and 1983, precipitation and stream water were sampled weekly for quantity and chemical composition in two small watersheds in the Catoctin Mountains of central Maryland. Both watersheds are underlain by metabasaltic rock consisting of chlorite, albite, epidote and actinolite and minor amounts of calcite and quartz. Precipitation recorded in 1983 was approximately 60% greater than in 1982, but the discharge of streams draining watersheds (which accounted for 50% of the precipitation input) remained relatively constant. Hydrogen, sulfate, and nitrate were the major ions in precipitation, whereas calcium, magnesium, and bicarbonate were the major ions in stream water. Seasonally high concentrations were observed for sulfate and hydrogen ions in precipitation during the summer. In stream water, concentrations of bicarbonate were elevated during the summer. Sodium and chloride concentrations in stream water were elevated during the spring because of the large quantities of deicing salts applied to the main roads during the winter months. Mass balances for major dissolved constituents show that dissolved solids from precipitation input account for 12 to 19% of the total dissolved load in stream water. Approximately 50% more sulfate left each watershed annually than entered in precipitation. Dry deposition of sulfur species apparently accounts for this excess sulfate. Geochemical weathering processes account for the observed changes in the chemistry of the streamflow. Dissolution of albite and calcite account for 60 to 90% of the neutralization of the total hydrogen-ion input from precipitation and from carbonic acid weathering. Even though calcite is present in extremely small quantities in the bedrock, its dissolution significantly affects water chemistry because of its relatively high reactivity and location in the hydrologic flow path. (Author's abstract)
W88-10518

PURGEABLE ORGANICS IN GREAT LAKES RAW AND TREATED WATER,
Environmental Health Directorate, Ottawa (Ontario).
R. Otson.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 1, p 41-53, November 1987. 1 fig, 3 tab, 15 ref. Health and Welfare Canada Contracts 885 and 891 (1982) and 1000 and 1002 (1983).

Descriptors: *Great Lakes, *Water pollution, *Chemical analysis, *Municipal water, *Water treatment, *Volatile organic compounds, Gas chromatography, Mass spectrometry, Pollutant identification, Trihalomethanes, Seasonal variation, Row water, Toluene, Dichloroacetonitrile, Styrene, Canada, Performance evaluation.

The occurrence of 51 volatile organics in water supplies at nine municipalities along the Great Lakes (Canada) and for a well water supply was examined by a GC-MS (gas chromatography-mass spectrometry) technique. Only dichloromethane (max. 19.0 micrograms/l) and chloroform (17.0 micrograms/l) were detected at concentrations above 10.0 micrograms/l and bromodichloromethane, chlorodibromomethane, dichloroacetonitrile, toluene, and styrene were detected at least once above 1.0 micrograms/l. Aggregate levels of the 19 organics detected at > or = 0.1 microgram/l were generally about the same in treated and raw water when values for trihalomethanes (THM) and dichloroacetonitrile were excluded. THM values did not exceed 32 micrograms/l. The aggregate frequency and the mean of aggregate organics levels were noticeably lower for raw water in winter than in summer or spring. Overall, the water treatment at the sites was not very effective in removal of relatively low levels (0.1 to 5 micrograms/l) for the volatile organics from raw water. There were no evident trends to the occurrence of organics along the Great Lakes system. Levels of organics in raw and treated water were generally about the same as, or lower than, those previously found in other Canadian surveys. (See also W88-10528) (Author's abstract)
W88-10530

BIOACCUMULATIVE BEHAVIOUR OF SOME PCB CONGENERS IN LAKE GENEVA BROWN TROUT (SALMO LACUSTRIS L.),
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. du Genie de l'Environment.
D. Rossel, P. Honsberger, and J. Tarradellas.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 219-233, November 1987. 7 fig, 45 ref.

Descriptors: *Lake Geneva, *Switzerland, *Path of pollutants, *Polychlorinated biphenyls, *Bioaccumulation, *Trout, Lakes, Water pollution, Pollutant identification, Chemical analysis, Tissue analysis, Fish.

The bioaccumulation of PCBs (polychlorinated biphenyls) has been studied for 60 brown trout in Lake Geneva (Switzerland). The contamination level (1-3 ppm in wet weight, 10-30 ppm in lipid weight) is rather high. Bioaccumulation curves (concentration as a function of the weight of the fish) have been established for 6 congeners and total PCBs. The total concentration of PCBs in wet weight increased with the weight of the fish; highly-chlorinated congeners (I.U.P.A.C. no. 180, 2,3,4,5,2',4',5'-heptachlorobiphenyl) presented a faster, and lightly-chlorinated (I.U.P.A.C. no. 28, 2,4,4'-trichlorobiphenyl) a slower, bioaccumulation tendency. The total concentration of PCBs in lipid weight was constant, the concentration of congener 28 increasing and of congener 180 decreasing with the weight of the fish. This is attributed to the antagonistic effects of 'growth and lipid dilution' and of the decrease of elimination kinetics as a function of the weight (and age) of the fish. The partitioning theory and the pharmacokinetic approach are complementary methods for analyzing these field data. (Author's abstract)
W88-10536

DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN INDIGENOUS AND TRANSPLANTED MUSSELS (MYTILUS EDULIS L.) ALONG THE DUTCH COAST,
Hoofdgroep Maatschappelijke Technologie TNO, Apeldoorn (Netherlands).
For primary bibliographic entry see Field 5A.
W88-10537

FLOW INJECTION ANALYSIS OF HYDROGEN PEROXIDE, SULFITE, FORMALDEHYDE AND HYDROXYMETHANESULFONIC ACID IN PRECIPITATION SAMPLES,
Netherlands Energy Research Foundation ECN, Petten.
For primary bibliographic entry see Field 5A.
W88-10538

QUALITY ASSURANCE STUDY FOR THE ANALYSIS OF HYDROCARBONS IN SEDIMENTS,
Instituto de Quimica Bio-Organica, Barcelona (Spain). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W88-10539

LIQUID CHROMATOGRAPHIC DETERMINATION OF CATIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES USING A CONTINUOUS POST-COLUMN ION-PAIR EXTRACTION DETECTOR WITH A SANDWICH PHASE SEPARATOR,
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W88-10540

ACCUMULATION OF COPPER AND COBALT BY BLUE-GREEN ALGAE AT DIFFERENT TEMPERATURES,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
R. M. Sharma, and P. A. Azeez.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 32, No. 1, p 87-95, January 1988. 2 fig, 2 tab, 29 ref.

Descriptors: *Water pollution effects, *Thermal pollution effects, *Algae, *Bioaccumulation, *Temperature effects, Thermal pollution, Copper, Cobalt, Cyanophyta, Survival, Plant physiology.

Two species of blue-green algae Anacystis nidulans and Spirulina platensis, grown in artificial aqueous culture medium, were treated with Cu and Co at different temperatures to study accumulation of these elements by the organisms. Metal concentrations used were 0.5, 1.0, 2.0 and 4.0 ppm at different temperatures, viz., 25, 30, 35, 40, and 45 C. Both of these species showed high capacity to accumulate the metals. Concentration factors (CF) were in the range of 1000-10,000. Metal accumulation followed the relation $m=KC$ to the n power where m = molar concentration of metal in the algae, C = molar concentration of initial total metal in the medium, K and n = constants. Metal accumulation by algae was higher at high temperature than at lower temperatures. A negative correlation between metal accumulated and the survival ratio of the algae when treated with different metals was observed, indicating the importance of passive absorption mechanism. (Author's abstract)
W88-10541

ANALYSIS OF DISPERSE YELLOW 42 IN ENVIRONMENTAL SAMPLES,
Bayreuth Univ. (Germany, F.R.). Chair of Ecological Chemistry and Geochemistry.
For primary bibliographic entry see Field 5A.
W88-10542

CLUSTER ANALYSIS AS A TOOL IN THE STUDY OF GROUNDWATER QUALITY,
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W88-10546

DEPOSITION OF MERCURIC CHLORIDE ON THE SURFACE OF WATERS,
Service Cantonal d'Ecotoxicologie, Geneva (Switzerland).
F. Cupelin, and J.-Cl. Landry.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 32, No. 3-4, p 269-278, February 1988. 3 fig, 2 tab, 7 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Mercury, *Air pollution, *Water pollution sources, Atmosphere, Model studies.

The deposition rate of atmospheric mercuric chloride particles on the surface of waters was determined. The laminar film model used gave a value of 19 plus or minus 3 cm/min for the deposition rate. The rate and spatial pattern of deposition of mercurie chloride particles into natural waters is controlled by their aerodynamic resistance or fallout velocity in the gaseous phase. (Brock-PTT)
W88-10547

DETERMINATION OF NITRITE BY REVERSE FLOW INJECTION ANALYSIS,
Murcia Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W88-10548

CONTAMINATION OF THE SUPERFICIAL WATERS OF THE GULF OF FOS-SUR-MER BY ANIONIC DETERGENTS,
Centre d'Oceanologie de Marseille (France).
R. Siron.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 33, No. 1, p 35-41, February 1988. 1 fig, 1 tab, 20 ref.

Descriptors: *Path of pollutants, *Fos-sur-mer Gulf, *Surfactants, *Oil pollution, Surface water, Anionic surfactants, Petroleum, Salinity, Water pollution, Mediterranean Sea, Synergistic effects.

Concentrations of anionic surfactants were found in the range of 135-902 ppb. This confirms the chronic pollution of the Gulf of Fos-sur-mer (France, Mediterranean Sea). Evidence is given for the heterogeneous distribution of surfactants in superficial waters. The hydrology of this site contributes to the dispersion and transport of these pollutants. Surface film does not appear very enriched in comparison with the underlying water. However, the highest concentrations of anionic surfactants are related to low salinities, revealing that freshwater inputs are the major source for surfactants in this coastal area. Consequently, strong damage to marine ecosystems due to synergistic actions between surfactants and petroleum pollutants can be predicted at this site. (Author's abstract)
W88-10549

ANALYSIS OF SUBSURFACE STRATIGRAPHY OF THE SANITARY LANDFILL, URBANA, ILLINOIS,
Illinois Univ., Urbana. Dept. of Geology.
J. C. Yarnold, and C. J. Mann.
Transactions of the Illinois Academy of Science TISAAH, Vol. 80, No. 3-4, p 83-85, 1987. 2 fig, 1 ref.

Descriptors: *Landfills, *Path of pollutants, *Stratigraphy, *Groundwater movement, *Groundwater pollution, *Leachates, Urbana, Illinois, Wells, Boneyard Creek, Vermilion River, Clay, Sand, Waste disposal.

Data were collected from water wells, monitor wells, and other available sources with the aim of providing meaningful geologic information about the probability of leachate movement from the Urbana, Illinois, sanitary landfill to nearby Boneyard Creek (Saline Branch of Salt Fork, Vermilion River). The Urbana sanitary landfill is underlain by clay to a depth of about 20 m and by permeable sands to a depth of at least 70 m beneath the surface. The water table exists roughly 5 to 7 m beneath the surface in clayey sediment and shows a significant depression toward Boneyard Creek, indicating groundwater movement from the permeable sediment into the creek. If any leachate escapes the constructed seal to the landfill, it has a good probability of being carried directly into the stream. (Author's abstract)
W88-10551

THROUGHFALL CHEMISTRY (METSIKKOSADAMAN LAATU),
Finnish Forest Research Inst., Helsinki. Dept. of Peatland Forestry.
A. Patila.
Aquilo, Ser. Botanica ASBOD8, Vol. 25, No. 1, p 29-37, 1987. 1 fig, 4 tab, 13 ref.

Descriptors: *Throughfall, *Acid rain, *Coniferous forests, *Precipitation, *Chemistry of precipitation, Pine trees, Spruce trees, Birch trees, Finland, Seasonal variation, Sulfur, Ammonium, Nitrates, Calcium, Potassium, Magnesiums.

Throughfall chemistry was studied in pine, spruce and birch stands situated in different parts of Finland. Samples were collected using systematically sited polyethene funnels (26-36/plot) and bottles. Sampling was done after each rainfall event. The mean volume-weighted interception loss was 7-29% in pine stands, 29-36% in spruce stands and 10-20% in birch stands. When the element concentrations or deposition values in the stands were compared to those of open areas, the highest H(+) and SO4 values were found beneath the spruce stands, probably as a result of the leaching of sulfur, derived from dry deposition and effectively absorbed by spruce. The acidity of throughfall was lowest beneath birch stands, but effective neutralization compared to free precipitation was only apparent during the autumn months. Ammonium and nitrate were intercepted by the foliage of all tree species. Leaching of calcium, magnesium and especially potassium from the foliage was high. Although differences in absolute deposition values of the throughfall between tree species were evident, the percentage composition of the deposition was nearly the same in all stands and did not differ much from that of free precipitation. (Author's abstract)
W88-10559

EFFECT OF ACIDIFICATION ON MOBILITY OF HEAVY METALS AND ALUMINUM IN FOREST AND LAKE ECOSYSTEMS (HAPPAMOITUMISEN VAIKUTUS RASKASMETALLIEN JA ALUMIININ LIIKUVUUTEEN METSA-JA JARVIEKO SYSTEEMISSA),
Helsinki Univ. (Finland).
P. Nuorteva, S. Autio, K. Bergbom, H.

Braunschweiler, and E. Koski.
Aquilo, Ser. Botanica ASBOD8, Vol. 25, No. 2, p 122-128, 1987. 6 fig, 1 tab.

Descriptors: *Acid rain effects, *Heavy metals, *Acidic water, *Lakes, *Aluminum, *Path of pollutants, *Bioaccumulation, Forests, Ecosystems, Finland, Tissue analysis, Mercury, Zinc, Cadmium, Catchment areas, Birch trees, Herbivores.

In Espoo, Southern Finland, an acidified lake (Hauklampi) and a non-acidified lake (Kurkijarvi) and their catchment areas were surveyed. Heavy metal and aluminum analyses were performed on plants and animals. In terrestrial environments the contents of mercury did not differ between the study areas, but aluminum, zinc and cadmium contents were higher in plants in the surroundings of the acidified lake. The heavy metal contents in animals in the acidified lake were clearly higher than in the non-acidified lake. The contents in animals living in the catchment area did not differ in the same way as in plants. In some species accumulation of metals occurred, but the elevation did not follow the rules of accumulation. In the summer of 1986 birches were artificially exposed to cadmium, and the effect on herbivore resistance was studied. No effects were observed, but natural resistance to herbivores tended to differ considerably. (Author's abstract)
W88-10560

SORPTION OF COPPER AND CADMIUM FROM THE WATER-SOLUBLE FRACTION OF AN ACID MINE WASTE BY TWO CALCAREOUS SOILS,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
L. M. Dudley, J. E. McLean, R. C. Sims, and J. J. Jurinak.
Soil Science SOSCAK, Vol. 145, No. 3, p 207-214, March 1988. 7 fig, 3 tab, 29 ref.

Descriptors: *Acid mine drainage, *Path of pollutants, *Carbonates, *Mine wastes, *Heavy metals, *Soil absorption capacity, *Calcareous soils, Copper, Zinc, Metal finishing wastes, Computer programs, Cadmium.

The water extract of a milling waste, containing concentrations of Cu, Cd, and Zn in excess of Environmental Protection Agency (1974) drinking water limits in batch systems was reacted with 2 calcareous soils to determine the mechanisms and rates of Cu and Cd sorption. The pH of the extract was 4 to 4.5, and the predominant anion was SO4. The computer program GEOCHEM was used to calculate metal activities in the equilibrated suspensions. Calculated activities of Cu and Cd indicated that the suspensions of soil containing 30% carbonate were undersaturated with respect to oxide and carbonate pure solid phases at the lower levels of metal addition. As additions of Cu and Cd increased, the activities approached the solubility of tenorite (CuO) and octavite (CdCO3), respectively. At low levels of addition, adsorption on carbonate surfaces apparently controlled solution concentrations. Carbonates dissolved from the soil containing 0.2% carbonates, and desorption with 0.01 M CaCl2 suggested that cation exchange processes were involved in metal sorption. The sorption of Cu, Cd, and Zn required 14 days to reach time-invariant concentrations in suspensions of the soil containing 30% carbonates, but only about 1 day in the 0.2% carbonate soil suspension. (Author's abstract)
W88-10570

BIODEGRADATION AND ADSORPTION OF LINEAR ALKYLBENZENE SULFONATES (LAS) IN THE RIVER ENVIRONMENT - A CASE STUDY ON RIVER AKASHI OF HYOGO PREF., (IN JAPANESE),
Hyogo Prefecture Environmental Science Inst., Kobe (Japan).
Y. Kobuke.
Japanese Journal of Limnology RIZAA, Vol. 49. No. 1, p 27-36, January 1988. 8 fig, 2 tab, 24 ref.

Descriptors: *Rivers, *Lotic environment, *Adsorption, *Alkylbenzene sulfonates, *Biodegradation, *Fate of pollutants, *Path of pollutants, Microorganisms, Aquatic habitats, Bacteria, Japan, River Akashi.

The behavior of Linear Alkylbenzine Sulfonates (LAS) in river waters was investigated in a medium-size river of Hyogo Prefecture in November 1985 and March 1986. The LAS concentration was high in lower streams traversing urbanized areas and also relatively high in upper streams passing through newly developed housing districts. The distribution of LAS-assimilating bacteria was similar to that of LAS, and the correlation between the two concentrations was significant. Four LAS homologs with C10 to C13 alkyl chain were detected in river waters. The relative abundance of LAS homologs is governed by 'the distance principle' according to which biodegradation of LAS is facilitated by increasing the distance between a sulfonate group and the most remote end of the alkyl chain. The change of the relative abundance of LAS homologues was closely related with the increase of suspended sediment (SS) concentration in the middle reaches of the river. A laboratory experiment showed that the relative abundance of LAS homologues with longer alkyl chain decreased with as adsorption of total LAS onto SS took place. These results suggest that both adsorption on SS and biodegradation play an important role in the change of LAS composition in the river water. (Author's abstract)
W88-10574

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): IV. HEAVY METALS IN RECENT LACUSTRINE SEDIMENTS,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
A. Tatur, and K. Stasiak.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 233-240, 1985. 1 fig, 1 tab, 16 ref.

Descriptors: *Limnology, *Jorka River, *Path of pollutants, *Water pollution, *Poland, *Heavy metals, *Lakes, *Lake sediments, Rivers, Watersheds, Zinc, Lead, Nickel, Copper, Cobalt, Mercury.

Heavy metals (Zinc, Pb, Ni, Cu, Co, Hg) and phosphorus were investigated in short cores (up to 40 cm) taken from 4 lakes for the purpose of estimating the degree of heavy metal pollution of these lakes. P, Zn, Cu, and Pb enrichment of surface sediment, observed in Lake Mikolajskie, is mainly due to anthropogenic factors, as well as to the increase of Hg concentration in all lakes studied. The vertical distribution of metals in other lakes investigated seems to be under control of natural factors, independent of human activity. (See also W88-10590) (Author's abstract)
W88-10593

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): V. NUTRIENT INPUT WITH AIR TRANSPORT,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
W. Goszczynska.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 241-269, 1985. 17 fig, 8 tab, 43 ref.

Descriptors: *Limnology, *Path of pollutants, *Fallout, *Jorka River, *Lakes, *Cycling nutrients, *Poland, Dusts, Catchment areas, Allochthonous matter, Watersheds, Rivers, Air transport, Erosion, Phosphorus, Nitrogen, Organic carbon, Dry matter, Wind erosion, Seasonal variation.

The dust-fall on drainage basins of four lakes of the Jorka River watershed was investigated between September 1977 and August 1979. The dust-fall was estimated (in g/sq m) along with concentrations of C org., N tot. and P tot. Spatial and seasonal differentiation of the amount of dust-fall, the relation between dust-fall and wind erosion of soils and meterological conditions, and the relation between the amount of C org., N tot. and P tot. and the dust-fall are presented. The significance of allochthonous matter reaching the lake with air transport was pointed out. (See also W88-10590) (Author's abstract)
W88-10594

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VI. NUTRIENT INPUT WITH WATER TRANSPORT,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
W. Lawacz, W. Goszczynska, C. Kurowski, and K. Tomaszewski.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 217-300, 1985. 5 fig, 14 tab, 25 ref.

Descriptors: *Limnology, *Eutrophication, *Jorka River, *Nonpoint pollution sources, *Lakes, *Nutrients, *Poland, Watercourses, Rivers, Nonpoint pollution sources, Precipitation, Flow discharge, Chemical composition, Water pollution sources.

The input of chosen chemical components (C org., N(N org. + N-NH4), P tot. and K(+), Na(+), Ca(2+), Mg(2+), Cl(-) to 3 lakes was estimated. The inflow by watercourse point sources was determined on the basis of monthly measurements of water flow in the course of a year and chemical analyses of water and suspension. The input brought by non-point sources was calculated assuming that 1 running meter of shore line is responsible for the same load for the lake as an average running meter of shore line of watercourses running into that lake. The input provided by way of precipitation was estimated. (See also W88-10590) (Author's abstract)
W88-10595

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VII. INPUT AND REMOVAL OF NUTRIENTS WITH FISH,
Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Penczak, M. Molinski, W. Galicka, and A. Prejs.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 301-309, 1985. 5 tab, 18 ref.

Descriptors: *Limnology, *Jorka River, *Lakes, *Nutrients, *Fish farming, *Aquaculture, *Poland, *Eutrophication, Rivers, Watersheds, Nutrient removal, Flow discharge, Carbon, Nitrogen, Phosphorus, Fish farming, Tissue analysis.

Qualitative and quantitative data for fishing and angling (kg/ha/yr) were collected for four Masurian lakes. Dry weight of carbon, nitrogen and phosphorus was determined in homogenates of whole fish. The average intensity of nutrient removal during several years was: 2.3 kg C, 0.13 kg N and 0.13 kg P/ha/yr; when including angling the values increased to 3.2 C, 0.77 N, 0.15 P kg/ha/yr, respectively. In Lake Glebokie, as a result of rainbow trout cage culture, in food, metabolism products, and feces the following here introduced per sq m/yr; 27.91 g C, 3.58 g N and 0.84 g P. The amounts removed by harvesting the fish were: 4.83 g C, 0.96 g N and 0.18 g P. (Author's abstract)
W88-10596

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): IX. THE EXCHANGE OF PHOSPHORUS BETWEEN SEDIMENTS AND WATER,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
M. Planter, and R. J. Wisniewski.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 329-344, 1985. 4 fig, 3 tab, 19 ref.

Descriptors: *Limnology, *Jorka River, *Sediment-water interfaces, *Lakes, *Rivers, *Lake sediments, *Phosphates, Seasonal variation, Oxygen demand, Path of pollutants, Eutrophication, Water pollution sources, Thermal stratification.

In complex studies of four lakes of the Jorka River watershed the exchange of PO4-P between sediments and the near-bottom water was analyzed using the method of short-term incubations of undisturbed sediment cores together with near-bottom water. The studies were conducted during summer and winter stagnation, and the spring and summer circulation. In spring, summer and winter the sediments in lakes examined released phosphates, whereas in autumn they absorbed them from the near-bottom water. During summer stagnation the maximal release rates were 11.0 mg P/sq m/day in the mesotrophic lake, and up to 21.2 mg P/sq m/day in the eutrophic polluted lake. At that time 83-96% of annual PO4-P release by sediments were realized. Under anoxic conditions the amount of PO4-P released by sediments was directly proportional to phosphate concentration in interstitial water. Under oxic conditions the direction and quantity of PO4-P exchange between sediments and adjacent water depends on the concentration of phosphates in the near-bottom water. (See also W88-10590) (Author'abstract)
W88-10598

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): XI. NUTRIENT BUDGET WITH SPECIAL CONSIDERATION TO PHOSPHORUS RETENTION,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W88-10600

SESTON OF THE WARSAW REACH OF THE VISTULA RIVER IN 1982 AND 1983: II. DRY WEIGHT AND ORGANIC CARBON,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W88-10602

POLLUTION OF SURFACE WATERS IN AN AGRICULTURAL WATERSHED ON THE EXAMPLE OF THE SUCHA RIVER.
Institute of Meteorology and Water Management, Warsaw (Poland).
L. Jakubowska, and T. Suchecka.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 547-561, 1985. 3 fig, 7 tab, 9 ref.

Descriptors: *Rivers, *Nutrients, *Agricultural watersheds, *Nonpoint pollution sources, *Water pollution sources, Watersheds, Water pollution, Surface water, Poland, Sucha River.

Two years of studies of the Sucha River in the Warsaw Basin, in a mixed agricultural and forested watershed (no intensive farming) without point sewage discharge, showed a high concentration on nutrients (in mg/cu dm) in the river water: NO3-N up to 10, N org. up to 6.2, NH4-N up to 3.4, P tot. up to 2.4, and K up to 5.3. Concentrations of inorganic forms of nitrogen showed a positive correlation with the water flow. Since the Sucha watershed is representative of the hydrological-physiological region of the Warsaw Basin, it can be assumed that agriculture similarly affects other rivers in the region. (Author's abstract)
W88-10609

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: VII. HYDROCHEMISTRY,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 2H.
W88-10618

MODELING OF LOSSES OF SOIL-APPLIED CHEMICALS IN RUNOFF: LATERAL IRRIGATION VERSUS PRECIPITATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
R. Wallach, W. A. Jury, and W. F. Spencer.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 3, p 605-612, May/June 1988. 3 fig, 19 ref, append.

Descriptors: *Agricultural chemicals, *Path of pollutants, *Nonpoint pollution sources, *Water pollution sources, *Flood irrigation, *Runoff, Soil water, Water quality, Chemical properties, Model studies, Mixing.

The differences between rainfall- and surface irrigation-induced runoff are described in relation to the transfer of the surface-applied chemicals for soil solution to surface runoff water in the absence of infiltration. The different processes inducing runoff are characterized by the residence time distribution (RTD) of the water in the system. The time-dependent chemical concentration at the field outlet is affected by the RTD, even for the case of instantaneous equilibrium between chemicals in runoff water and soil solution. In this approach, the water and chemical transport process in the field is represented by linear well-stirred mixing cells in series, for which a general solution for the effluent concentration is available. The rainfall- and irrigation-induced runoff processes, which are represented by complete mixing and plug flow models, respectively, form the two limiting cases for the actual chemical transport process by runoff. For each of these two extremes, mixing in the system is characterized by the parameter n, which is the number of cells in the series chosen to represent the actual transport process over the field. (Author's abstract)
W88-10642

TRANSFER OF CHEMICALS FROM SOIL SOLUTION TO SURFACE RUNOFF: A DIFFUSION-BASED SOIL MODEL,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
R. Wallach, W. A. Jury, and W. F. Spencer.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 3, p 612-618, May/June 1988. 4 fig, 1 tab, 18 ref, 3 append.

Descriptors: *Water pollution sources, *Nonpoint pollution sources, *Model studies, *Path of pollutants, Diffusion, Soil water, Runoff, Air-earth interfaces, Boundary layers, Adsorption, Chemical transport, Concentration, Hydrographs.

A physically-based diffusion and transport model is developed to describe chemical outflow concentration during chemical removal from soil to overlying runoff water induced by continuous rainfall over the soil surface. In contrast to earlier models, movement from the soil to the runoff water is described as a liquid diffusion process to the surface, coupled to the runoff zone through a laminar boundary layer at the runoff interface with the soil surface. Within the soil, diffusion is moderated by equilibrium adsorption to solid surfaces characterized by a partition coefficient. The runoff concentration at the outlet is derived by treating the runoff zone as a well-mixed reactor, characterized by a residence time. The model was used to predict the results obtained in an experimental study where infiltration was suppressed, with good agreement obtained between predicted and measured outflow concentration when the model parameters were estimated independently using standard engineering equations from channel flow hydraulics. The model also predicted the final soil concentrations satisfactorily after runoff ceased. (Author's abstract)
W88-10643

TRANSPORT OF A CONSERVATIVE TRACER IN THE FIELD UNDER CONTINUOUS FLOOD IRRIGATION,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. B. Jaynes, R. S. Bowman, and R. C. Rice.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 3, p 618-624, May/June 1988. 7 fig, 1 tab, 34 ref.

Descriptors: *Solute transport, *Flood irrigation, *Water pollution sources, *Groundwater pollution, *Dispersion, *Dispersivity, *Leaching, *Pore water, *Soil water, *Path of pollutants, Soil porosity, Model studies, Laboratories, Capillary water, Velocity curve, Tracers.

A 5-cm deep pulse of bromide-tagged water was applied to four small field subplots and leached under continuously flooded conditions for 7 d. During leaching, solution samples were periodically withdrawn through suction samplers from seven depths within each subplot. Pore water velocities, v sub s, and dispersion coefficients, D, were calculated by fitting the one-dimensional solution of the advection-dispersion equation to the concentration vs. time curves from each sampler. Both v sub s and D were best described by a log-normal distribution rather than a normal distribution. D values were very large compared to values reported for laboratory experiments, but similar to other field values measured under similar conditions. Neither v sub s nor D showed any significant correlation with depth or time, but the dispersivity (ration of D to v sub s) did show a weak positive correlation with depth. The relationship between ln D and ln v sub s was linear with a slope near 1.0. However, when v sub s and D data measured in an earlier study under an intermittently dosed irrigation regime at the same site were included, ln D was no longer a simple linear function of ln v sub s. The ratio between the calculated pore water velocities and the velocities calculated form the surface flux divided by the average water content was equal to or slightly < 1.0 for all depths > 0.6 m. At depths < 0.6 m, the ratio was considerably > 1.0, indicating that a fraction of the soil water was being bypassed or not participating in the leaching process. This result is in contrast to an earlier study conducted on this site when irrigated under a dose irrigation scheme in which the ratio was consistently > 1.0 at all depths. (Author's abstract)
W88-10644

OCCURRENCE OF PHOSPHORUS AND ITS POTENTIAL REMOBILIZATION IN THE LITTORAL SEDIMENTS OF A PRODUCTIVE ENGLISH LAKE,
Vermont Univ., Burlington. Dept. of Geology.
For primary bibliographic entry see Field 2H.
W88-10663

IN VITRO STUDIES ON SULFATE REDUCTION AND ACIDIFICATION IN SEDIMENTS OF SHALLOW SOFT WATER LAKES,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
J. A. A. R. Schuurkes, and C. J. Kok.
Freshwater Biology FWBLAB, Vol. 19, No. 3, p 417-426, June 1988. 3 fig, 4 tab, 31 ref.

Descriptors: *Acid rain, *Organic matter, *Sulfates, *Sediments, *Lakes, Hydrogen ion concentration, Acidity, Oxidation, Sediment-water interfaces, Sampling, Metabolism, Sulfides.

The sulfate reduction capacity of six shallow soft water sediments, differing in pH and organic matter content, was studied under controlled pH adjustments ranging from pH 3 to pH 8. In the acid sediments, relatively rich in organic matter, the sulfate reduction capacity reached values of 0.09-0.12 micro mol per g per d. In the circumneutral mineral sediments the values ranged between 0.04 and 0.08 micro mol per g per d. The mineral sediments were very sensitive to the effects of experimental acidification as sulfate reduction was almost fully inhibited when pH decreased from 7 to 5. In the acid sediments inhibition occurred at lower pH values, in the range pH 5 to pH 3. Sulfate reduction governed the production of free sulfides, whereas putrefaction processes were only of minor importance. It is suggested that in acid sediments, relatively rich in organic matter, the sulfate reducing bacterial population is less sensitive to acidification than in circumneutral mineral sediments. The presence of organic matter appeared to be important in counteracting the inhibiting effects of acidification on sulfate reduction. This is important for the in situ sulfate reduction in sediments of soft waters which become enriched with organic matter during the long-term process of acidification. (Author's abstract)
W88-10674

DENITRIFICATION IN A SAND AND GRAVEL AQUIFER,
Geological Survey, Lakewood, CO. Water Resources Div.
R. L. Smith, and J. H. Duff.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 5, p 1071-1078, May 1988. 5 fig, 4 tab, 43 ref.

Descriptors: *Nitrates, *Denitrification, *Aquifers, *Groundwater pollution, Solute transport, *Path of pollutants, *Fate of pollutants, Limiting nutrients, Detection limits, Groundwater, Plumes, Self-purification, Cape Cod, Massachusetts.

Denitrification was assayed by the acetylene blockage technique in slurried core material obtained from a freshwater sand and gravel aquifer on Cape Cod, Massachusetts. The aquifer, which has been contaminated with treated sewage for more than 50 years, had a contaminant plume greater than 3.5 km long. Near the contaminant source, groundwater nitrate concentrations were greater than 1 mM, whereas 0.25 km downgradient the central portion of the contaminant plume was anoxic and contained no detectable nitrate. Samples were obtained along the longitudinal axis of the plume (0 to 0.25 km) at several depths from four sites. Denitrification was evident at in situ nitrate concentrations at all sites tested; rates ranged from 2.3 to 260 pmol of N2O produced/hour. Rates were highest nearest the contaminant source and decreased with increasing distance downgradient. Denitrification was the predominant nitrate-reducing activity; no evidence was found for nitrate reduction to ammonium at any site. Denitrifying activity was carbon limited and not nitrate limited, except when the ambient nitrate level was less than the detection limit, in which case, even when amended with high concentrations of glucose and nitrate, the capacity to denitrify on a short-term basis was lacking. These results demonstrate that denitrification can occur in groundwater systems and, thereby, serve as a mechanism for nitrate removal from groundwater. (Author's abstract)
W88-10737

MICROBIAL DEGRADATION OF ACENAPHTHENE AND NAPHTHALENE UNDER DENITRIFICATION CONDITIONS IN SOIL-WATER SYSTEMS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
J. R. Mihelcic, and R. G. Luthy.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 5, p 1188-1198, May 1988. 10 fig, 45 ref. DOE Contract DE-AC18-84FC10619.

Descriptors: *Denitrification, *Soil water, *Hydrocarbons, *Microbial degradation, *Fate of pollutants, *Organic compounds, Hydraulic conductivity, Microbiological studies, Acenaphthene, Naphthalene, Organic carbon, Mineralization, Limiting nutrients, Nitrates, Metabolism.

This study examined the microbial degradation of acenaphthene and naphthalene under denitrification conditions at soil-to-water ratios of 1:25 and 1:50 with soil containing approximately 100,000 denitrifying organisms per g of soil. Under nitrate-excess conditions, both acenaphthene and naphthalene were degraded from initial aqueous-phase concentrations of about 1 and several mg/liter respectively, to nondetectable levels (< 0.01 mg/liter) in less than 9 weeks. Acclimation periods of 12 to 36 days were observed prior to the onset of microbial degradation in tests with soil not previously exposed to polycyclic aromatic hydrocarbon (PAH) compounds, whereas acclimation periods were absent in tests with soil reserved from prior PAH degradation tests. It was judged that the apparent acclimation period resulted from the time required for a small population of organisms capable of PAH degradation to attain sufficient densities to exhibit detectable PAH reduction, rather than being a result of enzyme induction, mutation, or use of preferential substrate. About 0.9% of the naturally occurring soil organic carbon could be mineralized under denitrification conditions, and this accounted for the greater proportion of the nitrate depletion. Mineralization of the labile fraction of the soil organic carbon via microbial denitrification occurred without an observed acclimation period and was rapid compared with PAH degradation. Under nitrate-limiting conditions the PAH compounds were stable owing to the depletion of nitrate via the more rapid process of soil organic carbon mineralization. Soil sorption tests showed at the initiation of a test that the total mass of PAH compound was divided in comparable proportions between solute in the aqueous phase and solute sorbed on the solid phase. The microbial degradation of the PAH compound depends on the interrelationships between (i) the desorption kinetics and the reversibility of desorption of sorbed compound from the soil, (ii) the concentration of PAH-degrading microorganisms, and (iii) the competing reaction for nitrate utilization via mineralization of the labile fraction of naturally occurring soil organic carbon. (See also W88-10740) (Author's abstract)
W88-10739

DEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBON COMPOUNDS UNDER VARIOUS REDOX CONDITIONS IN SOIL-WATER SYSTEMS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
J. R. Mihelcic, and R. G. Luthy.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 5, p 1182-1187, May 1988. 4 fig, 29 ref. DOE Contract Number DE-AC18-84FC10619.

Descriptors: *Denitrification, *Hydrocarbons, *Soil water, *Microbial degradation, *Microbiological studies, *Fate of pollutants, *Organic compounds, *Anaerobic conditions, *Aerobic conditions, Hydraulic conductivity, Aromatic compounds, Organic carbon, Acenaphthene, Naphthalene, Mineralization, Limiting nutrients, Nitrates, Naphthol.

This study evaluated the microbial degradation of naphthol, naphthalene, and acenaphthene under aerobic, anaerobic, and denitrification conditions in soil-water systems. Chemical degradation of naphthol and naphthalene in the presence of a manganese oxide was also studied. Naphthol, naphthalene, and acenaphthene were degraded microbially under aerobic conditions from initial aqueous-phase concentrations of 9, 7, and 1 mg/liter to nondetectable levels in 3, 10, and 10 days, respectively. Under anaerobic conditions naphthol degraded to nondetectable levels in 15 days, whereas naphthalene and acenaphthene showed no significant degradation over periods of 50 and 70 days, respectively. Under denitrification conditions naphthol, naphthalene, and acenaphthene were degraded from initial aqueous-phase concentrations of 8, 7, and 0.4 mg/liter to nondetectable levels in 16, 45, and 40 days, respectively. Acclimation periods of approximately 2 days under aerobic conditions and 2 weeks under denitrification conditions were observed for both naphthalene and acenaphthene. Abiotic degradation of naphthalene and naphthol were evaluated by reaction with manganese oxide, a minor soil constituent. In the presence of a manganese oxide, naphthalene showed no abiotic degradation over a period of 9 weeks, whereas the aqueous naphthol concentration decreased from 9 mg/liter to nondetectable levels in 9 days. The results of this study show that low-molecular-weight, unsubstituted, polycyclic aromatic hydrocarbons are amenable to microbial degradation in soil-water systems under denitrification conditions. (See also W88-10739) (Author's abstract)
W88-10740

PROBLEMS AND POTENTIAL FOR IN SITU TREATMENT OF ENVIRONMENTAL POLLUTANTS BY ENGINEERED MICROORGANISMS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5G.
W88-10743

POLYCYCLIC AROMATIC HYDROCARBON CONCENTRATIONS FROM WATERSHEDS WITH VARYING DEGREES OF INDUSTRIALIZATION,
Gannon Univ., Erie, PA. Dept. of Biology.
D. R. Plowchalk, and S. J. Zagorski.
Proceedings of the Pennsylvania Academy of Science PPASAK, Vol. 60, No. 2, p 174-178, 1986. 1 fig, 1 tab, 18 ref.

Descriptors: *Industrial wastes, *Aromatic compounds, *Hydrocarbons, *Water pollution sources, *Path of pollutants, Aquatic habitats, Watersheds, Pollutant identification, Chromatography, Spectrophotometry, Sediments.

The specific types and concentrations of polycyclic aromatic hydrocarbons (PAHs) found in the sediment of an aquatic ecosystem, were studied in relationship to the degree of industrialization of its feeding waters. The watersheds supplying the study area were classified according to several criteria as to their state of 'industrialization'. Sediment samples were collected at each watershed inflow point, and analyzed by gas chromatography and fluorescence spectroscopy for PAH content. The results of this study demonstrate that the greater the industrial burden on a watershed, the greater the concentration PAHs in the sediment of the aquatic ecosystem into which it empties. This suggests that the sediment PAH content is strongly dependent upon the condition of the contributing watersheds. (Author's abstract)
W88-10747

DIFFUSIVE LIMIT FOR ENTRAINMENT,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W88-10763

CHANGES IN THE UNDER-ICE CHARACTERISTICS OF LA GRANDE RIVIERE PLUME DUE TO DISCHARGE VARIATIONS,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
R. G. Ingram, and P. Larouche.
Atmosphere-Ocean ATOCDA, Vol. 25, No. 3, p 242-250, September 1987.

Descriptors: *Thermal pollution, *Canada, *James Bay, *Rivers, *Hydroelectric plants, *Plumes, Salt rejection, Stratification, Turbulent flow, La Grande Riviere, Runoff, Ice formation.

The under-ice plume characteristics for La Grande Riviere (James Bay) in northern Quebec are described for February 1984 when the runoff levels were six times the natural rate as a result of hydroelectric development. The results show the different effects of landfast and dynamic ice on upper-layer mixing and offshore plume expansion. The areal extent of the river was more than three times larger than for natural runoff levels. Reduced turbulence under the continuous landfast ice zones allows for plume dilution of the James Bay surface waters over 100 km north of the river at February 1984 discharge levels. Offshore of the 20-25 km wide landfast ice zone, the upper water column is generally well mixed. This occurs because of wind-generated turbulence and salt rejection during ice formation on the open land areas formed intermittently by the offshore transport of ice floes. Further increases in the midwinter discharge will lead to dilution of the near-shore surface waters in southeast Hudson Bay. Comparison of the 1984 data set with those obtained for lower discharges in previous years enabled the extrapolation of the plume extent for the higher runoffs planned for the future. (Miller-PTT)
W88-10776

SURFACE AND SUBSURFACE WATER CONTRIBUTIONS DURING SNOWMELT IN A SMALL PRECAMBRIAN SHIELD WATERSHED, MUSKOKA, ONTARIO,
Trent Univ., Peterborough (Ontario). Watershed Ecosystems Program.
For primary bibliographic entry see Field 2E.
W88-10777

OIL SPILL BEHAVIOR MODEL OF THE CANADIAN ATMOSPHERIC ENVIRONMENT SERVICE: PART I. THEORY AND MODEL EVALUATION,
Atmospheric Environment Service, Downsview (Ontario).
S. Venkatesh.
Atmosphere-Ocean ATOCDA, Vol. 26, No. 1, p 93-108, March 1988. 9 fig, 21 ref.

Descriptors: *Path of pollutants, *Model studies, *Marine environment, *Tidal currents, *Parametric hydrology, Water currents, Simulation, Water pollution, Oil pollution, Bay of Fundy.

A model to simulate the behavior of oil spills in marine environments includes parametrizations of various physical processes representing the movement and weathering of an oil slick. The movement of the slick is affected by wind-driven, tidal and residual water currents. Turbulent dispersion is an important mechanism influencing the horizontal spreading for time periods greater than about a day. The model was used to simulate successfully the movement of spill-following buoys deployed in the Bay of Fundy, where some of the strongest tidal currents in the world occur. The ability of the model to simulate the horizontal spreading of an oil slick was evaluated with observed data from the Argo Merchant oil spill for a 10-day period. It was found that the observed shape and extent of the spill could be fairly well described by the parametrization of the turbulent dispersion effects. (See also W88-10780) (Author's abstract)
W88-10779

OIL SPILL BEHAVIOR MODEL OF THE CANADIAN ATMOSPHERIC ENVIRONMENT SERVICE: PART II. EVALUATION OF MODEL GUIDANCE FOR EMERGENCY RESPONSE,
Atmospheric Environment Service, Downsview (Ontario).
S. Venkatesh, V. R. Neralla, W. Hume, N. Parker, and B. Thomson.
Atmosphere-Ocean ATOCDA, Vol. 26, No. 1, p 109-117, March 1988. 7 fig, 7 ref.

Descriptors: *Canada, *Path of pollutants, *Model studies, *Oil spills, *Oil slicks, *Marine environment, Simulation, Water pollution, Oil pollution, Diesel oil.

The use of the Canadian Atmospheric Environment Service oil spill behavior model to provide guidance in support of the emergency created by an oil spill in the Canadian Beaufort Sea is discussed. The spill of about 2440 barrels of diesel oil occurred in September 1985 as a result of storm damage to an artificial island used for hydrocarbon exploration. Model simulations were carried out for two time periods while the spill was being tracked. These simulations identified the marked shifts in the direction of the movement of the spill. While the predictive skills for the two periods varied, the final observed slick location was predicted to within 2 km with re-initialization. This model prediction was used by the regulatory authorities as guidance information in locating the slick when it could not be easily spotted from the air. The prediction of the size of the slick 27 hours after initial time was in very good agreement with observations. A qualitative evaluation of the model-simulated weathering of the oil was also carried out. Movement of the slick was a function of wind-driven and residual water currents; the main processes involved in the weathering of the slick were emulsification and evaporation. The model studies showed that the slick size or extent is a function of the duration over which the oil is released. (See also W88-10779) (Miller-PTT)
W88-10780

HYDROGEOLOGICAL STUDY IN THE BASIN OF GULP CREEK, A RECONNAISSANCE IN A SMALL CATCHMENT AREA: PART 3. CHEMISTRY OF SURFACE AND GROUND WATER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 2F.
W88-10786

RECOMMENDATIONS FOR WATER QUALITY INVESTIGATION OF DRINKING WATER SUPPLY RESERVOIRS IN CZECHOSLOVAKIA,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
M. Straskraba, I. Nesmerak, N. Stybnarova, P. Blazka, and Z. Brandl.
Limnologica LMNOA8, Vol. 17, No. 2, p 201-212, October 1986. 3 fig, 1 tab, 23 ref.

Descriptors: *Sampling, *Water quality control, *Reservoirs, *Water quality management, Eutrophication, Long-term planning, Data storage and retrieval, Drinking water, Czechoslovakia.

Methods are recommended for the routine investigation of reservoir water quality in Czechoslovakia by control agencies. The reservoir water quality control system suggested is based on the ideas of data used for direct comparison with normatives, for estimating eutrophication and suggesting management options, for water quality simulations and prognoses. Reservoirs are classified basically as small (V < or = 1.0 times 10 to the 6th power sq m or water supply < or = 501/s) and large as well as stratified vs. non-stratified. Two basic plans of investigation are distinguished: (a) orientation investigation for small reservoirs, sampling twice a year in the periods of full stratification and autumnal isothermy. Samples are taken in the reservoir and in the inflow, only total phosphorus is measured; (b) systematic investigation, once a month in the inflow, reservoir and outflow. The parameters to be measured include temperature, dissolved oxygen, pH, sulfide, transparency, chlorophyll-a, nitrates, nitrites, ammonia, total phosphorus, and COD anbd BOD; methods to be used are outlined. Methods of computer data retrieval and elaboration are given. (Friedmann-PTT)
W88-10805

LONG-TERM TRENDS IN WATER CHEMISTRY OF THE VLTAVA RIVER (CZECHOSLOVAKIA),
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
L. Prochazkova, and P. Blazka.
Limnologica LMNOA8, Vol. 17, No. 2, p 263-271, October 1986. 1 fig, 7 tab, 20 ref.

Descriptors: *Rivers, *Reservoirs, *Chemical properties, *Water column, *Vltara River, *Water pollution sources, *Agricultural watersheds, Chemical analysis, Water analysis, Phosphorus, Sodium, Potassium, Magnesium, Trace elements, Organic compounds, Nitrogen, Surface waters, Fertilizers, Agricultural runoff, Seasonal variation, Czechoslovakia, Data collection.

The long-term trends in chemical characteristics of the Vltava River at Slapy Reservoir were evaluated for the period 1959-1980. The analysis was based on the surface values that may be considered representative for the trends in the whole water column in all parameters studied except total and reactive phosphorus. A small, but systematic increase in concentration at the surface during the summer is probably caused by evaporation. Three groups of the time relationship were found: (1) A group with a positive exponential relationship both to time and flow rate (NO3(-), SO4(2-), Cl-, Ca(2+), and conductivity). Fertilization rate increases linearly with time (r = 0.993); (2) A group comprising parameters increasing linearly with time (Na+, K+, Mg(2+), reactive P, NO2(-), and organic N); (3) In the group consisting of total P, ammonia and alkalinity, all without any significant relation to time and COD which decreased in the period studied. These trends are reflected in the changing ratios of major constituents particularly anions. Nitrate became one of the major anions, bicarbonate was overbalanced by sulfate and partially chloride. Waters coming from intensively fertilized watersheds, originally bicarbonate, are changing into sulfatochloride waters with a substantial share of nitrate. (Author's abstract)
W88-10813

NITRATES AND MINERAL NITROGEN FERTILIZATION,
Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
I. Nesmerak.
Limnologica LMNOA8, Vol. 17, No. 2, p 273-281, October 1986. 6 fig, 5 tab, 9 ref.

Descriptors: *Nitrates, *Water pollution sources, *Agricultural watersheds, *Fertilizers, *Quantitative analysis, *Statistical analyis, Nitrogen, Mineral wWater analysis, Chemical analysis, Runoff, Catchments, Regression analysis, Agricultural chemicals, Leakage.

The relationship of concentration (y), and load (L) and percentage leakage of nitrate nitrogen in a watershed (profile) to the specific doses of mineral nitrogen fertilizers (d), specific runoff (q sub t), and percentage drainage area (op) were analyzed. These relationships were evaluated by analyzing time sequences of annual data for 12 watersheds (time profile) as well as by analyzing situations in 56 watersheds for selected years 1970 and 1980 (space profile). The basic nitrate nitrogen concentration (y sub 0) was introduced, corresponding to zero fertilization (d) and zero drainage (op). Multiple power type regressions were calculated. Time profile evaluation showed that percentage leakage is directly proportional to specific runoff (q sub t) and dose (d), the dependence for q sub t being statistically significant, but for d, usually not. Similar evaluations of the space profile for 56 watersheds was not as evident, because it was not possible to estimate y sub 0 due to inadequate data. (Author's abstract)
W88-10814

POSSIBILITY OF ASSESSING THE TROPHIC POTENTIAL IN ORGANICALLY POLLUTED WATERS,
Ceskoslovenska Akademie Ved, Prague.
For primary bibliographic entry see Field 5D.
W88-10815

INPUT OF DECOMPOSABLE ORGANIC MATTER AND BIOMASS CONCENTRATION IN THE PLANKTON OF RESERVOIRS,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
V. Straskrabova.
Limnologica LMNOA8, Vol. 17, No. 2, p 283-290, October 1986. 2 fig, 6 tab, 23 ref.

Descriptors: *Decomposing organic matter, *Biomass, *Phytoplankton, *Zooplankton, *Reservoirs, *Cycling nutrients, Seasonal variations, Flushing, Organic compounds, Sampling.

The concentration of biomass in the plankton of three reservoirs was evaluated. The reservoirs differed substantially in size, mean depth and theoretical flushing rate. Two reservoirs were regularly sampled for a 10-year period, which included the years with an extreme hydrological regime. The average concentrations of bacteria, phytoplankton and zooplankton during the cold and warm half-year periods were transformed into energetic units. The inputs of decomposable organic substances both from inflow and primary production were expressed in comparable units for the respective periods. Total biomasses were directly correlated to total inputs for both cold and warm seasons, but indirectly correlated to flushing rates. Under the same flushing rate and input, the biomasses in warm seasons were higher than those in the cold seasons. The product of flushing rate and biomass concentration (biomass output) was significantly correlated to the inflow inputs during warm seasons. During cold seasons, the correlation was significant only for the heterotrophic component. Equations were derived, which could be used for predicting the average autotrophic and heterotrophic biomass concentration from the flushing rate and BOD in the inflow. (Author's abstract)
W88-10816

DEVELOPMENT OF WATER QUALITY IN THE HUSINEC RESERVOIR,
Ceskoslovenska Akademie Ved, Prague. Ustav Krajinne Ekologie.

P. Porcalova.
Limnologica LMNOA8, Vol. 17, No. 2, p 325-333, October 1986. 8 fig, 4 tab, 18 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Agricultural runoff, *Nitrates, *Water analysis, *Trophic levels, *Reservoirs, Drinking water, Phytoplankton, Biomass, Chlorophyll, Chemical analysis, Cycling nutrients, Czechoslovakia, Phosphorus, Husinec Reservoir.

Results of three years of observations of water quality in the Husinec Reservoir are presented with special reference to phytoplankton biomass, the chlorophyll-phosphorus relation, and the load budge of nutrients in the reservoir. The phosphorus-chlorophyll relationship was used to determine the trophic level and to evaluate the possibilities of drinking water supply. The negative effect of agricultural pollution upon water quality was demonstrated by the high values of nitrates in the reservoir. The increase was more than two-fold over the period 1970-1980. The effect of flow rate on NO3(-)-N load was shown, as was a strongly nonlinear negative dependence of concentrations on flow rates exists. No accumulation of nitrates in the reservoir was observed; on the contrary, the outflow concentration exceeded that at the inflow. Phytoplankton was quantitatively evaluated using the values for chlorophyll, species abundance and calculated biomass. Chlorophyll and phytoplankton abundance correlated well. (Author's abstract)
W88-10820

INFLUENCE OF THE WATERSHED AND FISHSTOCK UPON THE FISH POND BIOCENOSES,
Ceskoslovenska Akademie Ved, Prague. Ustav Krajinne Ekologie.
J. Komarkova, R. Faina, and J. Parizek.
Limnologica LMNOA8, Vol. 17, No. 2, p 335-354, October 1986. 10 fig, 10 tab, 41 ref.

Descriptors: *Agricultural runoff, *Phytoplankton, *Water pollution sources, *Fish ponds, Aquatic populations, Chemical analysis, Water analysis, Zooplankton, Microbiology, Ponds, Algae, Cycling nutrients, Biomass.

The chemistry, microbiology, phytoplankton quality and quantity, zooplankton and zoobenthos were observed for three years in two ponds with different watersheds. The load from agricultural land resulted in increased concentrations of N-forms (except NH4(+)-N) and in an increase of bacterial numbers, but in no case did the phytoplankton production rise. Nutrients were raised to concentrations superfluous for algae. Biological and chemical conditions of the ponds were governed by biomass of fishstock to such a degree, that inflow quality differences were not detectable. Interactions between fishstock, zooplankton and phytoplankton indicate that the fishstock regulates the composition and abundance of zooplankton by predation and the same mechanism regulates the zooplankton-phytoplankton relationship. A high fishstock was followed by increases in total phosphorus, phosphate, ammonium, and COD. (Friedmann-PTT)
W88-10821

MERCURY PROBLEM IN RECENTLY FORMED RESERVOIRS OF NORTHERN MANITOBA (CANADA): EFFECTS OF IMPOUNDMENT AND OTHER FACTORS ON THE PRODUCTION OF METHYL MERCURY BY MICROORGANISMS IN SEDIMENT,
National Hydrology Research Inst., Saskatoon (Saskatchewan).
For primary bibliographic entry see Field 6G.
W88-10823

INFLUENCE OF MOLECULAR WEIGHT AND MOLECULAR VOLUME ON DIETARY ABSORPTION EFFICIENCY OF CHEMICALS BY FISHES,
Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi, and B. G. Oliver.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 222-227, February 1988. 1 fig, 2 tab, 55 ref.

Descriptors: *Organic compounds, *Path of pollutants, *Fish diets, *Rainbow trout, *Metabolism, Chemical properties, Fish physiology, Molecular structure, Absorption, Water pollution effects, Fish populations, Population exposure.

Rainbow trout (Salmo gairdneri) were exposed to 17 halogenated organic chemicals to examine the influence of molecular weight (MW) and molecular volume (MV) on dietary absorption efficiency. The results of this and other studies indicated that organic chemicals with MWs greater than 600 were poorly absorbed although some chemicals with lower MWs were also poorly absorbed. A better trend was suggested when efficiencies were examined in relation to MV where chemicals with MVs over 0.3 cu nm were poorly absorbed. Neither index provided a relationship that would consistently estimate the absorption efficiency of chemicals that were moderately to well-absorbed by salmonids. (Author's abstract)
W88-10828

CHEMICAL FRACTIONATION AND BIOAVAILABILITY OF COBALT-60 TO BENTHIC DEPOSIT-FEEDERS,
Trent Univ., Peterborough (Ontario). Trent Aquatic Research Centre.
R. D. Evans, D. Andrews, and R. J. Cornett.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 228-236, February 1988. 7 fig, 1 tab, 23 ref.

Descriptors: *Cobalt, *Food habits, *Path of pollutants, *Chemcial speciation, *Bioavailability, *Cobalt radioisotopes, *Benthic fauna, Chemical properties, Aquatic animals, Bottom sediments, Heavy metals, Cores, Chemical reactions, Organic compounds.

Concentrations of radiocobalt (60Co) and stable Co were measured in a series of sequential chemical extractions of freshwater sediment cores and in benthic deposit-feeding organisms. In all sediment samples, a large fraction of the stable Co was measured in the strong-acid (residual) extract. Co concentrations in the exchangeable and carbonate-bound fractions decreased with depth in the core, while Co concentrations in the oxide- and organic-bound or sulfide-bound fractions increased. We hypothesize that the changes in Co partitioning result from the decrease in E sub h with depth as FeCO3 dissolves and FeS2 forms. 60Co added to sediments was incorporated quickly by the exchangeable, carbonate-bound, and oxide-bound fractions. Very little 60Co was measured in the organic and residual fractions although these fractions contained more than 50% of the total stable Co. The specific activity of 60Co in organisms (Becquerels 60Co per microgram total Co) that were incubated in sediments spiked with radiocobalt was similar to the specific activity of the exchangeable, carbonate, and oxide fractions. The large percentage of Co in the organic concentration to sediment concentration) for radioactive Co was the same as that of stable Co from the first three fractions only, which suggest that there may be a relationship between concentration factors and the bioavailable fraction of a contaminant. Specific activity may provide a simple measure of the bioavailable fraction of substances. (Author's abstract)
W88-10829

EFFECTS OF CADMIUM, COPPER, AND LOW PH ON ION FLUXES IN THE RAINBOW TROUT, SALMO GAIRDNERI,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
S. D. Reid, and D. G. McDonald.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 244-253, February 1988. 9 fig, 3 tab, 55 ref.

Descriptors: *Cadmium, *Copper, *Acidic water, *Ion transport, *Acid rain effects, *Rainbow trout, *Water pollution effects, Population exposure, Fish populations, Biochemistry, Toxicity, Heavy metals, Metabolism.

Adult and juvenile rainbow trout, Salmo gairdneri, acclimated to high and low water Ca levels, were statically exposed to equimolar concentrations (approx. 6.5 micromol/L) of Cd or Cu at circumneutral pH or pH 4.8 either alone or in metal/H+ combinations for 24 h. Unidirectional fluxes of Ca2+ and Na+ were measured by means of radiotracers and terminal blood samples were drawn for analysis of Ca2+ fluxes. Cadmium specifically inhibited Ca2+ influx, while having no effect on Ca2+ efflux and only minor effects on Na+ fluxes. The inhibition of Ca2+ influx by Cd was modulated by water Ca2+ content. Copper altered net Na+ flux and plasma Na+ in trout, while having only a transient effect on Ca2+ homeostasis. The effects of Cu on the net Na+ fluxes of trout were not modulated by either water Ca2+ or pH. Hydrogen ion perturbed Ca2+ dynamics predominantly by stimulating Ca2+ efflux, while reducing influx only slightly. Exposure to elevated H+ (pH 4.8) had no significant effect on net Na+ balance over the 24-h period. These data indicate significant differences in the toxic mechanisms of three metals with similar ligand binding chemistry. (Author's abstract)
W88-10830

EFFECT OF MASS CHEMOTHERAPY AND PIPED WATER ON NUMBERS OF SCHISTOSOMA HAEMATOBIUM AND PREVALENCE IN BULINUS GLOBOSUS IN KWALE, KENYA,
Kagoshima Univ. (Japan). Dept. of Medical Zoology.
For primary bibliographic entry see Field 6B.
W88-10840

SHIGELLOSIS ASSOCIATED WITH RECREATIONAL WATER CONTACT IN LOS ANGELES COUNTY,
Los Angeles County Dept. of Health Services, CA.
F. J. Sorvillo, S. H. Waterman, J. K. Vogt, and B. England.
American Journal of Tropical Medicine and Hygiene AJTHAB, Vol. 38, No. 3, p 613-617, May 1988. 1 fig, 3 tab, 16 ref.

Descriptors: *Water pollution sources, *Public health, *Swimming, *Shigellosis, *Human diseases, *Pathogens, Human pathology, Population exposure, Sewage, Public water, Recreation, Shigella, California.

An outbreak of shigellosis associated with swimming at a human-made lake during the Labor Day weekend occurred in Los Angeles County in 1985. Sixty-eight persons had onset of diarrheal illness within 1 week following exposure at the recreational site. Thirty-three of these cases were culture-confirmed as shigellosis (29 Shigella sonnei, 4 Shigella boydii). Fifteen persons were hospitalized. Illness was highly associated with water contact, specifically swallowing water while swimming ($P < 0.001$) and age < 15 years ($P < 0.001$). Water samples from the swimming area had high fecal coliform counts; however, dye testing showed no evidence of sewage contamination. Direct bather contamination of the swimming areas may have occurred in the context of large crowds, inadequate restroom facilities, poor water exchange, and the absence of a mechanism of disinfection. (Author's abstract)
W88-10841

SCHISTOSOMIASIS IN SAUDI ARABIA,
King Faisal Univ., Damman (Saudi Arabia). Dept. of Family Health and Community Medicine.
Z. A. Sebai.
Annals of Saudi Medicine, Vol. 8, No. 3, p 169-174, May 1988. 1 fig, 2 tab, 21 ref.

Descriptors: *Parasites, *Schistosomiasis, *Public health, *Saudi Arabia, *Human diseases, Human pathology, Population exposure, Snails, Infection.

This article discusses the prevalence of schistosomiasis in Saudi Arabia and the problems facing its control. Saudi Arabia is located between two of the major endemic schistosomiasis areas in the

world, the Nile River and the Tigris and Euphrates valley. Four species of snail vectors exist in the country. The main natural habitat of the vector snails appears to be in the Sarawat mountains where there are various natural water sources. About 6.5% of the population suffers from schistosomiasis. The disease in general is predominant among the lower age group and affects males more than females. The infection rate is heavy along the permanent and main streams and moderate to low in remote areas. If control measures are carried out appropriately, schistosomiasis need not be a problem in Saudi Arabia by the year 2000. (Author's abstract)
W88-10843

BEHAVIOURAL EFFECTS OF CHEMICALLY DISPERSED OIL AND SUBSEQUENT RECOVERY IN DIPLORIA STRIGOSA (DANA),
Bermuda Biological Station for Research, Ferry Reach.
S. C. Wyers, H. R. Frith, R. E. Dodge, S. R. Smith, and A. H. Knap.
PSZNI: Marine Ecology, Vol. 7, No. 1, p 23-42, 1986. 6 fig, 5 tab, 51 ref.

Descriptors: *Oil spills, *Dispersants, *Corals, *Animal behavior, *Water pollution effects, Laboratories, Population exposure, Chemical properties, Dose-response relationships, Animal physiology, Sublethal effects, Crude oil.

Survival and behavior of the hermatypic coral Diploria strigosa was studied during 6-24 h doses with water-accommodated fractions of chemically dispersed crude oil, and for a subsequent recovery period of 1 month. Experiments utilized a flow-through laboratory dosing procedure and incorporated petroleum hydrocarbon measurements in order to simulate a major but short-term oil spill in shallow subtidal benthic reef environments. Chemically dispersed oil treatments consisted of Arabian Light Crude oil with Corexit 9527 or BP1100 WD at 1-20 ppm concentrations of oil. In general, effects observed were sub-lethal, temporary, and associated with the highest concentrations tested. Responses to the presence of dispersed oil at 20 ppm for 24 h included mesenterial filament extrusion, extreme tissue contraction, tentacle retraction and localized tissue rupture. The nature and severity of reactions during the dosing phase varied between colonies and treatments, but colonies typically resumed normal behavior within 2 h to 4 d of the recovery period. It therefore seems unlikely that observed biological effects would impair long-term viability. (Author's abstract)
W88-10854

POLLUTION OF THE SEAS AROUND INDIA,
Department of Ocean Development, New Delhi (India).
For primary bibliographic entry see Field 5C.
W88-10860

RELATION OF LONG- AND SHORT-TERM ATMOSPHERIC SULFUR CONCENTRATIONS TO SULFATE DEPOSITION IN NEW YORK STATE,
Geological Survey, Raleigh, NC. Water Resources Div.
C. R. Barnes.
Northeastern Environmental Science NOESDE, Vol. 6, No. 2, p 89-96, 1987. 3 fig, 4 tab, 34 ref.

Descriptors: *Acid rain, *Particulate matter, *Path of pollutants, *Sulfates, *New York, Deposition, On-site data collections, Chemistry of precipitation, Air pollution, Rain gages, Time series analysis.

Air- and precipitation quality records from 1965-80 indicate and annual decrease of 1.9 percent in sulfur dioxide emissions upwind of New York, an annual decrease of 1.5 percent in atmospheric particulate sulfate concentration in New York, and an annual decrease of 2.0 percent in sulfate-deposition rate in New York. Sulfate-deposition rates in bulk sampling in New York during 1965-80 were approximately 40 percent of the average sulfur-emission rate for the Northeast. Atmospheric particulate sulfate and sulfur dioxide concentrations, and sulfate concentrations in bulk, wet, and dry deposition, were measured in the summer of 1984 just outside Albany, NY. Sulfate-deposition rates in bulk an wetfall collectors were nearly equal and were five times greater than in the dryfall collector. Scavenging ratios for sulfate averaged 8.9 times 10 to the fifth power; those for sulfate plus sulfur dioxide average 4.6 times 10 to the fifth power. Sulfate concentrations in wet deposition averaged more than twice those estimated from published regional-scale washout equations, whereas those in dry deposition averaged only 22 percent of those computed from deposition velocities of 0.1 cm/s for sulfate and 1.0 cm/s for sulfur dioxide. Discrepancies in the dryfall results are attributed to inefficiency of dryfall-collection equipment. (Author's abstract)
W88-10871

STUDY ON WATER QUALITY CHARACTERISTICS AND LONGITUDINAL DISPERSION COEFFICIENT OF SUYEONG ESTUARY, (IN JAPANESE),
Dong-A Univ., Pusan (Korea). Dept. of Environmental Engineering.
B. H. Lee, and J.-M. Lim.
Bulletin of the National Fisheries University, Pusan, Vol. 27, No. 2, p 45-51, 1987. 5 fig, 9 tab, 11 ref. English summary.

Descriptors: *Path of pollutants, *Estuaries, *Water pollution, *Water quality, Suyeong Estuary, Korea, Biological oxygen demand, Phosphates, Suspended solids.

The development of estuarine water quality modeling requires water quality characteristics and dispersion coefficients. A study was conducted to provide basic data for Suyeong Estuary water quality modeling. The mean value of water quality characteristics were as follows: BOD 32 mg/l, total suspended solids (TSS) 24 mg/l; total inorganic N 18 mg/l; phosphate-P 1 mg/l. Pollutant loadings were BOD 66 ton/d, TSS 46 ton/d, respectively. The range and mean values of the longitudinal dispersion coefficient were 55-475 sq m/sec and 180 sq m/sec. (Author's abstract)
W88-10897

URBAN STORMWATER FLOW RATE AND QUALITY PREDICTION: THE FLUPOL MODEL (PREVISION DES DEBITS ET DES FLUX POLLUTANTS TRANSITES PAR LES RESEAUX D'EGOUTS PAR TEMPS DE PLUIE: LE MODELE FLUPOL),
Compagnie Generale d'Automatisme, Paris (France).
For primary bibliographic entry see Field 4C.
W88-10904

PROCEEDINGS OF THE NWWA CONFERENCE ON SOLVING GROUND WATER PROBLEMS WITH MODELS.
For primary bibliographic entry see Field 2F.
W88-10912

MODELING MASS TRANSPORT WITH COMPETITIVE ION EXCHANGE,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, and W. A. Milne-Home.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 11-27, 7 fig, 1 tab, 28 ref.

Descriptors: *Solute transport, *Path of pollutants, *Groundwater pollution, *Mass transport, *Ion exchange, Model studies, Clays, Advection, Sandstone, Porous media, Mathematical models, Aquifers, Kaolinite, Illite, Montmorillonite, Dispersion.

A model described that is capable of simulating multi-component transport in a multi-exchanger system. It utilizes a two-step procedure, where concentrations of dissolved constituents are determined initially as a solution to the advection-dispersion equation and subsequently corrected to account for the partitioning of mass due to equilibrium ion exchange. The transport problem is solved using the method of characteristics, and the system of equations describing the exchange reactions uses an iterative, interval halving procedure. The model has been verified by comparison to well-known analytical solutions. Its accuracy depends upon the design of the grid in relation to the size of the time step because adding cation exchange reactions can generate considerable numerical dispersion. The model is applied to hypothetical media containing various clay minerals. Transport parameters for these media are generated using a series of empirical approaches based on grain size. In general, the results show the relative sensitivity of transport to the distribution of authigenic clay minerals. As expected, the greatest effects relate to differences in the cation exchange capacities of the exchange sites. There are, in addition, noticeable differences in the pattern of transport than can be related to changes in the advective velocity as a function of the clay mineralogy. (See also W88-10912) (Author's abstract)
W88-10914

DEVELOPMENT AND APPLICATION OF A MODEL FOR SIMULATING MICROBIAL GROWTH DYNAMICS COUPLED TO NUTRIENT AND OXYGEN TRANSPORT IN POROUS MEDIA,
Auburn Univ., AL. Dept. of Civil Engineering.
M. A. Widdowson, F. J. Molz, and L. D. Benefield.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 28-51, 15 fig, 2 tab, 33 ref.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Nutrients, *Oxygen transfer, *Microbial degradation, Model studies, Mathematical models, Biodegradation, Degradation, Organic compounds, Plumes, Porous media, Aerobic conditions, Anaerobic conditions, Hydrocarbons, Landfills, Solute transport, Microorganisms, Heterotrophic bacteria, Biodegradation.

A model capable of simulating organic contaminant transport and biodegradation coupled to electron acceptor transport was developed and generalized for two-dimensional application. The model applies to the growth and decay of aerobic, heterotrophic microorganisms whose growth is limited by lack of a carbon and energy source (substrate), an oxygen source, or both simultaneously. Transport of substrate and oxygen in the porous medium was assumed to be governed by advection-dispersion equations. A total of five coupled equations resulted. They describe substrate and oxygen concentration in the microcolonies and colony density. An iterative Eulerian-Lagrangian numerical procedure, highly resistant to numerical dispersion, was used to solve the overall model. The solution of the substrate and oxygen transport equations considering only the advective-dispersive processes was evaluated and compared to analytical solutions in both one and two dimensions. Results indicated that biodegradation would be expected to have a major effect on contaminant transport under proper growth conditions. Simulations of two-dimensional transport suggested that under aerobic conditions, microbial degradation reduces the substrate concentration profile along longitudinal sections of the plume and retards the lateral spread of the plume. Anaerobic conditions develop in the plume center due to microbial consumption and limited oxygen diffusion into the plume interior. Vertical domain simulations showed that high and low permeability layers significantly affect biodegradation. (See also W88-10912) (Cassar-PTT)
W88-10915

DEVELOPMENT AND APPLICATION OF A COUPLED GEOHYDROCHEMICAL CODE,
Battelle Pacific Northwest Labs., Richland, WA.
C. J. Hostetler, and R. L. Erikson.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 52-68, 13 fig, 2 tab, 9 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Geochemistry, Model studies, Mathematical models, Solute transport, FASTCHEM model, Aquifers, Cadmium, Heavy metals, Metals, Adsorption, Soil chemistry, EICM code, Computer models, Porous media, Ion exchange, Temporal distribution, Spatial distribution.

A two-step coupled geohydrochemical code was developed to model subsurface transport of solutes through porous media. The coupled code (EICM), part of the FASTCHEM modeling package, was designed to calculate the temporal and spatial distribution of aqueous solutes in a one-dimensional streamtube. The hydrologic model in EICM was based on the theory of Markov processes. Advection and hydrodynamic dispersion were defined by a set of linear operators containing the probability density function for distance traveled during a timestep. One linear operator was defined for each material domain in the streamtube. Linear operators for classical advection/dispersion as well as non-Fickian descriptions of dispersion were incorporated into the model. The Markov description was found to be efficient, stable, and mass conserving. The geochemical algorithm was designed to solve the nonlinear mass balance equations describing speciation, solubility, and adsorption reactions. Mass balance on all components, including water, was explicitly conserved. Activity corrections were performed using the Davies equation. Adsorption models included linear adsorption, ion exchange, and surface complexation submodels. The coupled model was applied to a problem involving the transport of cadmium through a shallow aquifer. The behavior of adsorption-sensitive components such as cadmium showed complex changes as an acidic influent solution traveled through alkaline sediments. The rate at which the neutralization front moved was sensitive to the initial masses of reactive soil constituents and the pH of the influent. For adequate prediction of solute migration in the subsurface, the system must be adequately characterized. This involves factors such as soil buffering capacity, amounts of reactive soil constituents, adsorption behavior, and composition of influent. (See also W88-10912) (Cassar-PTT)
W88-10916

SIMULATION WITH A COMPLEXATION-ADSORPTION MODEL OF POSSIBLE EFFECTS OF DISSOLVED HUMIC SUBSTANCES ON SOLUTE TRANSPORT IN SOILS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. LaFrance, O. Banton, J.-P. Villeneuve, and P. G. C. Campbell.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 69-91, 7 fig, 2 tab, 26 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Model studies, *Geochemistry, *Humic acids, Solute transport, Adsorption, Complexation, Unsaturated zone, Soil chemistry, Organic matter, Pesticides, Mathematical equations.

Simulations were made with a three-site adsorption-desorption model to determine the effects of humic substances on the aqueous behavior of organic contaminants, such as pesticides. Two kinetic rate equations and an equilibrium Freundlich equation were used to describe adsorption-desorption of two species of the contaminant (free or bound with dissolved humic substances) in a soil-water system. The equations governing pollutant adsorption and the transport equation were simultaneously solved using an explicit-implicit finite difference technique, under steady-state water flow conditions. The conceptual model described the effluent concentrations of a contaminant from a saturated soil column, assuming possible complexation and adsorption of this complex on the soil matrix. The use of different values for complexation-adsorption parameters and for rate constants showed the relative importance of these factors, and the possible effects of dissolved organic mater on the pollutant movement through the soil. These effects were predicted to be significant under some conditions that can occur in a soil-water system. These factors include the origin of the humic material and the variations with depth of the nature and concentrations of dissolved organic carbon in soil water. (See also W88-10912) (Cassar-PTT)
W88-10917

NUMERICAL SIMULATION OF MICROBIAL BIODEGRADATION OF HYDROCARBONS IN GROUND WATER,
Rice Univ., Houston, TX. Dept. of Mathematical Sciences.
M. F. Wheeler, C. N. Dawson, P. B. Bedient, C. Y. Chiang, and R. C. Borden.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 92-109, 7 fig, 1 tab, 10 ref. EPA Assistance Agreement CR-8128088.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Biodegradation, *Microbial degradation, *Hydrocarbons, *Model studies, Mathematical models, Dissolved oxygen, Biodegradation, Degradation, Organic compounds, Plumes, Aerobic conditions, Anaerobic conditions, Hydrocarbons, Landfills, Solute transport, BIOPLUME model, Wells, Injection wells, Oil wells, Oxygenation, Method of characteristic, Conroe, Texas.

A comprehensive groundwater contaminant transport model based on a modified method of characteristics (MOC) and a mixed Finite Element Method was developed. The MOC was combined with a Galerkin Finite Element Method for the transport equation, and the mixed Finite Element Method solved the flow equation. The overall advantages of the method include minimal numerical dispersion, minimal grid orientation problems under steep gradients, and reduced mass balance errors. The crucial aspect of the method is that it looks backward in time along an approximate flow path rather than forward in time as in the moving mesh technique. Much larger time steps can be taken compared to the Galerkin Finite Element Method with no loss in accuracy. The model was expanded to handle microbial biodegradation. It handles chemical components by a time-splitting method whereby the advection-dispersion terms are approximated by the modified MOC method and the reaction terms are combined with the time derivatives and treated as a system of ordinary differential equations. The three equations solved simultaneously include one each for hydrocarbons, dissolved oxygen, and microbial growth and decay. The method was tested against field data from the Conroe, Texas hazardous waste site and found to give reasonable results. The cases simulated included natural biodegradation of a hydrocarbon plume, injection of oxygenated water, injection of oxygenated water with simultaneous pumping of contaminated water, and Doublet injection-pumping configuration. The highest hydrocarbon concentrations computed after 7 years for the three treatments scenarios were 0.88, 0.75, and 0.1 mg/liter, respectively, with the Doublet configuration providing the best cleanup. (See also W88-10912) (Cassar-PTT)
W88-10918

SENSITIVITY ANALYSIS OF OPTIMAL GROUND WATER CONTAMINANT CAPTURE CURVES: SPATIAL VARIABILITY AND ROBUST SOLUTIONS,
Geological Survey, Menlo Park, CA.
S. M. Gorelick.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 133-146, 10 fig, 1 tab, 14 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Water quality control, *Model studies, Wells, Mathematical models, Injection wells, Sensitivity analysis, Plumes, Capture curve flow system, Transmissivity, Pilot, Spatial distribution.

A pilot study was conducted to explore a means for including spatial variability in transmissivity in a capture curve design for contaminated aquifer remediation. The capture curve (or interception envelope) uses pumping and injection wells to control the direction of subsurface water flow. Flow simulation and optimization methods were combined to determine the best layout of wells and pumping rates. The experimental approach used various simulations of transmissivities. The influence of spatial variability in transmissivity was quantified for these cases. It was demonstrated that the transmissivity simulations had a significant influence on well pattern layouts and total pumping rates. This proved to be true even when the number was restricted to one, two, or three wells. A new robust formulation was demonstrated that minimizes pumping for the maximum influence of tranmissivity variations. The method guarantees feasibility of the capture curve design for each and every sample simulation. It can provide worst case assurance that the pumping wells are in the best locations and pump adequately. (See also W88-10912) (Cassar-PTT)
W88-10920

DOUBLE-POROSITY TRACER-TEST ANALYSIS FOR INTERPRETATION OF THE FRACTURE CHARACTERISTICS OF A DOLOMITE FORMATION,
INTERA Technologies, Inc., Austin, TX.
V. A. Kelley, J. F. Pickens, M. Reeves, and R. L. Beauheim.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 147-169, 8 fig, 2 tab, 31 ref. Dept. of Energy Contract DE-AC04-76DP00789.

Descriptors: *Path of pollutants, *Groundwater pollution, *Geohydrology, *Fracture permeability, *Tracers, *Porosity, Model studies, Mathematical models, Wells, Permeability, Dolomite, Groundwater movement, Waste Isolation Pilot Plants, New Mexico, Geologic fractures, Hydraulic properties, Transmissivity, Solute transport.

A convergent-flow tracer test conducted in the Culebra Dolomite Member of the Rustler Formation of the Waste Isolation Pilot Plant site was analyzed using a double-porosity flow and transport model. The tracer test setup consisted of one pumping well and two tracer-addition wells arranged in an approximate equilateral triangle with 100-ft sides. The transport of conservative tracers from each of the tracer-addition wells was simulated using the double-porosity flow and transport model SWIFT II. The simulation model accounts for advective-dispersive transport in the fractures and diffusive transport in the matrix. Calibration of the tracer-breakthrough curves included conducting a sensitivity analysis on the important parameters: diffusion coefficient, tortuosity, matrix porosity, fracture porosity, effective matrix-block size, pumping rate, initial tracer input distribution, and distance between pumping and tracer-addition wells. Calibration of the tracer-breakthrough curves resulted in longitudinal dispersivities from 5 to 10% of the flow path length (well separation distance), a fracture porosity of 0.002, and effective matrix block sizes of 0.8 to 3.9 ft. Even though these estimates of fracture porosity and effective matrix block size were specific to the location of the tracer test, they provided an initial estimate on which to base predictions of the regional transport of solutes in the Culebra dolomite. (See also W88-10912) (Author's abstract)
W88-10921

DEVELOPMENT OF QUANTITY AND QUALITY MODEL FOR OPTIMAL GROUNDWATER MANAGEMENT,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
S. A. Prathapar, and R. C. Peralta.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 170-187, 8 fig, 8 ref.

Descriptors: *Path of pollutants, *Groundwater management, *Water quality control, *Model studies, Mathematical models, Solute transport, Boeuf Tensas Basin, Arkansas, Aquifers, Temporal distribution.

A groundwater quality model was developed as linear constraints in steady state groundwater management models. This equation accounts for initial level of contamination, change in contamination due to pumping, steady state flow and molecular diffusion. An application of the model to the Boeuf Tensas Basin in Arkansas showed that use of a single time step was unsatisfactory for modeling a 100-year period because contaminant moved beyond the one-cell radius of influence considered by the model. Performance improved with use of a three-step model. Subsequently, the model was incorporated as constraints in a groundwater management model with other physical and nonphysical constraints. (See also W88-10912) (Cassar-PTT) W88-10922

SOURCE TERM EQUATIONS AND SOLUTE TRANSPORT MODEL FOR CONSUMPTIVE USE PERMIT APPLICATION,

Environmental Science and Engineering, Inc., Gainesville, FL.
L. H. Motz.

IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 230-252, 12 fig, 1 tab, 13 ref.

Descriptors: *Path of pollutants, *Groundwater contamination, *Water quality control, *Saline water intrusion, *Consumptive use, *Permits, *Model studies, Floridan Aquifer, Fort George Island, Florida, Aquifers, Connate water, Groundwater movement, Solute transport, Groundwater management, Chlorides, Geohydrology, Wells, Hydraulic conductivity, Confined aquifers.

Equations were developed to calculate the flow rate of mineralized water into the Floridan Aquifer on Fort George Island near Jacksonville, Florida, where the aquifer has three permeable zones separated by relatively impermeable confining beds. In the island's northeast section, connate water from the lower zone apparently moves upwardly into the middle and upper zones through a vertical or nearly vertical conduit, which can be considered analogous to a large-diameter well filled with sediments of relatively high permeability. This upward flow from the lower zone occurs because the hydraulic head is higher in the lower zone than in the middle and upper zones. This upward movement causes an anomalous area of higher hydraulic head, temperature, and chemical concentrations in the island's northeast section. To quantify the hydraulic heads and flows in the anomalous area, hydraulic equations were developed and solved. Changes in chloride concentrations in the middle and upper zones were predicted using the U.S. Geological Survey solute transport model of Konikow and Bredehoeft. The equations describing flow rate versus hydraulic head relations in the source area were used to determine when the source term flow rate in the model could be treated as constant and when it had to be changed in response to water-level changes caused by regional trends and/or pumping on the island. Various scenarios were run representing conditions with and without pumping from the middle and upper zones. In general, the model predicted that the proposed pumping rates would not significantly increase the rate of change of chloride concentrations in the middle or upper zones. (See also W88-10912) (Author's abstract) W88-10925

PREDICTION OF THE FATE OF CHROMIUM FROM A PROPOSED MUNICIPAL SANITARY LANDFILL,

Foth and Van Dyke and Associates, Inc., Green Bay, WI.
F. J. Doran, and J. E. Thresher.

IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 253-282, 14 fig, 3 tab, 48 ref.

Descriptors: *Path of pollutants, *Landfills, *Model studies, *Groundwater pollution, *Chromium, Heavy metals, Waste disposal, Metals, Wisconsin, Mathematical models, Leachates, Solute transport, Standards, Drinking water, Prediction.

Model studies were conducted to determine impacts on groundwater downgradient from a proposed sanitary landfill with a natural attenuation silt-clay liner. The 9-acre landfill, located 40-50 ft above the water table, will have a disposal life of 15 years. Modeling was performed in three steps: leachate generation model, unsaturated zone transport model, and groundwater transport model. The model proved effective for predicting the fate of chromium in leachate. The groundwater impact analysis showed that groundwater quality would likely be impacted by chromium-bearing leachate. Chromium concentrations were predicted to be well below the Wisconsin NR 140 enforcement standards, 0.05 mg/liter chromium limit at a distance of 300 ft downgradient of the landfill. The preventive action limit, 0.005 mg/liter, would be exceeded by as much as 300%, but would eventually return to background levels. If all leachate is extracted for off-site treatment and disposal and a 70% liner efficiency is assumed, downgradient groundwater quality would exceed the preventive action limit by as much as 220% before returning to background levels. However, the drinking water standard, 0.05 mg/liter, would probably not be exceeded in the groundwater downgradient of the landfill. (See also W88-10912) (Cassar-PTT) W88-10926

REMEDIAL INVESTIGATION AND DESIGN FOR A MINE-TAILINGS WASTEWATER FACILITY IN SOUTHWESTERN WYOMING,

Weston (Roy F.), Inc., West Chester, PA.
W. S. Stevens, A. M. Klock, and R. T. Leigh.

IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 285-312, 11 fig, 2 tab, 14 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Water quality control, *Mine wastes, *Model studies, Industrial wastes, Mathematical models, Wyoming, Wastewater treatment, Ponds, PLASM model, Waste disposal, Aquifers, Aquitards, Pumping tests, Wells, Geohydrology, Simulation.

Since 1977 a 600-acre mine-tailings evaporation pond in southwestern Wyoming has leaked high total dissolved solids pond water into the shallow groundwater system. As a result, groundwater levels have risen, creating surficial expressions of groundwater in areas north and south of the pond. A detailed hydrogeological analysis identified a three-layer system consisting of a shallow water-bearing zone overlying an aquitard. A thick sequence of partially saturated sandstone and claystone occurs beneath the aquitard and has water levels 100 ft lower than the upper zone. Short-term pumping tests were conducted in wells located throughout the study area to obtain transmissivities, storage coefficients, and pumping water levels. Because of the low-transmissivity zones and the highly fractured rock matrix, pumping tests were analyzed using both block and fissure and casing storage type curves. The Prickett/Lonnquist Aquifer Simulation Model (PLASM) was used to simulate the three-layer system. The calibrated model was used to design a remedial action program to reduce groundwater levels and control flow in the areas affected by the groundwater seeps. A northern interceptor system was designed to reduce hydraulic heads and limit groundwater flow north of the mine-tailings pond. The flow rate required to lower groundwater levels below the root zone was determined using the flow model. This flow rate was then used to design an interceptor system consisting of eight wells. The required spacing and pumping rates of each of the eight interceptor wells were determined with an analytical Theis model. Maximum and minimum drawdown requirements to provide sufficient capture area were also determined using the Theis model. A southern interceptor system was simulated using the flow model, and consisted of a subsurface drain designed to reduce water levels below the root zone. The flow rate into the drain necessary to accomplish this goal was determined using the model.(See also W88-10912) (Cassar-PTT) W88-10927

ELIMINATING CONTAMINANT STAGNATION AREAS: A KEY TO OPTIMIZING GROUND WATER RECOVERY SYSTEM DESIGNS,

AWARE, Inc., West Milford, NJ.

For primary bibliographic entry see Field 5G. W88-10928

FIELD APPLICATIONS OF MULTIPLE-AQUIFER, GROUND WATER MODELS FOR FLOW AND TRANSPORT TO UNDERGROUND COAL GASIFICATION SITES,

Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
D. N. Contractor, and J. D. Schreiber.

IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 324-339, 10 fig, 12 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Coal gasification, *Groundwater movement, *Model studies, Mathematical models, Aquifers, Gasification, Hanna, Wyoming, Mass transport.

Two finite element models were developed to study flow and mass transport in a groundwater system of multiple aquifers. The models were applied to the study of groundwater movement around underground coal gasification cavities and transport of pollutants at two proposed burns scheduled for 1987 in Hanna, Wyoming. The flow program calculated the heads and velocities at all the nodes of a finite element grid consisting of eight-noded quadrilaterals. The output of this program was put into the water quality program to determine the distribution of pollutant concentrations as a function of time. The flow program was useful in understanding the mechanics of filling the cavities with water after the burn and the time of return of the piezometric head to the preburn conditions. The quality program showed that the initial unsteady flow conditions may not be very significant in the final distribution of pollutant concentrations 10 or 20 years later. In addition, the models can be used to evaluate the effectiveness of remedial action or treatment measures to reduce pollution. The withdrawal of polluted water and the reinjection of treated water can be simulated and the resulting distribution can be evaluated for effectiveness. (See also W88-10912) (Cassar-PTT) W88-10929

USE OF A MULTIGRID TECHNIQUE TO STUDY EFFECTS OF LIMITED SAMPLING OF HETEROGENEITY ON TRANSPORT PREDICTION,

Battelle Pacific Northwest Labs., Richland, WA.
C. R. Cole, and H. P. Foote.

IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 355-380, 17 fig, 22 ref. Dept. of Energy Contract DE-ACO6-76RLO 1830.

Descriptors: *Sampling, *Path of pollutants, *Groundwater pollution, *Groundwater movement, *Solute transport, *Model studies, Mathematical models, Heterogeneity, Aquifers, MGRID code, Finite difference methods, Hydraulic conductivity, Spatial variation.

Reliable groundwater transport prediction requires accurate spatial and temporal characterization of a hydrogeologic system. However, cost constraints and the desire to maintain site integrity by minimizing drilling can restrict the amount of spatial sampling that can be obtained to resolve the flow parameter variability associated with heterogeneities. This study quantifies the errors in subsurface transport predictions resulting from incomplete characterization of hydraulic conductivity heterogeneity. A multigrid technique was used to simulate two-dimensional flow velocity fields with high resolution. To obtain these velocity fields, the finite difference code MGRID was applied to compute stream functions on a 256-by-256 grid for a variety of hypothetical systems having detailed distributions of hydraulic conductivity. Particle

tracking was used to simulate transport, and results were evaluated on the basis of predicted arrival time curves at various distances from several source locations within these systems. A base case hydraulic conductivity distribution with a complex spatial correlation structure and a large coefficient of variation was generated from a topographic data set. Spatial variability in hydraulic conductivity distributions was characterized by the components in the spectrum of spatial frequencies. A low-pass spatial filtering technique was applied to the base case hydraulic conductivity distribution to produce a dataset with lower spatial frequency content. Arrival time curves were then calculated for filtered hydraulic conductivity distribution and compared to base case results to judge the relative importance of the higher spatial frequency components. Results indicate a progression from multimode to single-mode arrival time curves as the number and extent of distinct flow pathways are reduced by low-pass filtering. The relationship between transport predictions and spatial frequencies was used to judge the consequences of sampling the hydraulic conductivity with reduced spatial resolution. One implication is that as the sampling resolution decreases, the accuracy or the arrival time curve reflecting specific structural details within a system, and hence the precision of representing dispersive transport, are progressively degraded. (See also W88-10912) (Author's abstract)
W88-10931

SIMPLE MODEL FOR TRANSPORT OF FREE-PHASE ORGANICS IN UNSATURATED ZONES OF AQUIFERS,
Colorado Univ., Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
T. H. Illangasekare, and D. D. Reible.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 404-423, 6 fig, 3 tab, 24 ref. NSF Grant CEE-8405881.

Descriptors: *Path of pollutants, *Model studies, *Groundwater pollution, *Groundwater movement, *Plumes, *Organic compounds, Infiltration, Mathematical models, Chlorinated hydrocarbons, Oil pollution, Leakage, Tanks, Carbon tetrachloride, Tetrachloroethylene, Octane, Hydrocarbons, Solute transport, Soil contamination, Chloroform, Prediction, Phenols, Aeration zone, Methanol, Aquifers.

A simple lumped parameter model was developed to predict the fate of concentrated or free-phase organic chemicals spilled onto the ground or leaking from underground storage tanks. The model, based on the Green-Ampt models used in infiltration of water in unsaturated soils, assumes a piston front of the chemical displacing the air in the available pore space, corrected for the initial water saturation. Preliminary qualitative experiments did not provide adequate data to conclusively verify the model accuracy. However, they appear useful for crude exposure assessment estimates of organic transport. The chemicals exmployed for the experiment were selected to exhibit a range of densities and miscibilities with water. A wide range of interfacial tensions (and thus wetting characteristics) also were investigated. The chemicals used included immiscible organics, carbon tetracloride, tetrachloroethylene, 1-octane, 1-octanol, transmission oil-A, miscible organics, chloroform, phenol, and methanol. (See also W88-10912) (Cassar-PTT)
W88-10933

ROLE OF LEAKAGE IN THE SEA WATER INTRUSION OF A CONFINED COASTAL AQUIFER,
Montgomery (James M.), Inc., Walnut Creek, CA.
L. D. Bond.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 467-491, 16 fig, 4 tab, 20 ref.

Descriptors: *Leaky aquifers, *Groundwater movement, *Path of pollutants, *Groundwater contamination, *Model studies, *Saline water intrusion, Encroachment, Coastal aquifers, Aquifers, Pajaro Valley, California, Mathematical models, Alluvial aquifers, Confined aquifers, Leakage.

Sea water intrusion in the Pajaro Valley, California, was investigated by use of an areal, two-dimensional solute-transport computer model. This region has experienced 80 years of extensive groundwater development. Three pathways of possible intrusion were considered: (1) vertical leakage from brackish sources through the onshore confining layer; (2) vertical leakage from the ocean through the nearshore confining layer; and (3) lateral flow from the ocean through an offshore outcrop of the aquifer. Model simulations indicated that vertical leakage from the ocean, adjacent to the coast, was the principal pathway of seawater intrusion to the onshore portion of the aquifer, even though a lateral flow through the offshore outcrop has degraded the aquifer, as a whole, at a higher rate. The analysis suggests that a significant time interval follows the initial observation of seawater intrusion in poorly confined coastal aquifers before lateral offshore flow can impact the onshore portion of the aquifer. This interval may provide time for remedial action to control the largest component of seawater intrusion. (See also W88-10912) (Cassar-PTT)
W88-10936

APPLICATION OF A GROUND WATER MODEL FOR MANAGEMENT OF SEA WATER INTRUSION IN SALINAS VALLEY, CALIFORNIA,
Boyle Engineering Corp., Lakewood, CO.
R. R. Bennett, G. E. Snow, and Y. S. Yoon.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 492-513, 11 fig, 3 tab, 12 ref.

Descriptors: *Model studies, *Groundwater movement, *Path of pollutants, *Groundwater contamination, *Water quality control, *Saline water intrusion, Encroachment, Coastal aquifers, Aquifers, Salinas Valley, California, Mathematical models, Confined aquifers, Infiltration, Runoff, Irrigation-return flow.

A three-dimensional finite-element groundwater model was successfully applied to the 511-square-mile Salinas Valley, California basin to investigate management alternatives to alleviate seawater intrusion. Components of the model were seawater intrusion, infiltration, direct runoff, agricultural return flow, surface and subsurface inflows, stream-aquifer interactions, and reservoir operation. A special boundary condition was used to incorporate the density gradient between sea and fresh water at the aquifer-ocean interface. The basin contains three confined aquifers in the coastal area; these merge into a single unconfined aquifer in the Upper Valley. Approximately 270,000 acre-feet/year are recharged to the groundwater from the Salinas River, with the assistance of two reservoirs. Most of the 530,000 acre-feet/year pumped within the basin is used for agriculture, with about 30% returning to the groundwater as return flow. Seawater intrusion has average 15,000 acre-feet/year in response to basin overdraft. Management alternatives investigated were (1) no action; (2) reduction of pumping by 15%; and (3) the Castroville project, a combination of management options, including reduction of pumping by 10%. A graph of estimated salt water intrusion to the year 2020 indicated fluctuations from year to year but least intrusion with the Castroville scheme and most intrusion with no action. (See also W88-10912) (Cassar-PTT)
W88-10937

THREE-DIMENSIONAL MODELING ANALYSIS OF GROUND WATER PUMPING SCHEMES FOR CONTAINMENT OF SHALLOW GROUND WATER CONTAMINATION,
Papadopulos (S.S.) and Associates, Inc., Rockville, MD.
For primary bibliographic entry see Field 5G.
W88-10938

ADJOINT SENSITIVITY ANALYSIS FOR MASS TRANSPORT,
Conestoga-Rovers and Associates, Waterloo (Ontario).
K. D. Schmidtke, J. F. Sykes, and E. A. McBean.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 626-655, 14 fig, 1 tab, 12 ref.

Descriptors: *Adjoint sensitivity analysis, *Path of pollutants, *Model studies, *Groundwater, *Mass transport, Numerical analysis, Mathematical studies, Sensitivity analysis, Porosity, Mathematical equations, Solute transport.

The utility of an efficient alternative to conventional sensitivity analysis, the adjoint sensitivity technique, was examined. For numerical models in which each elemental or nodal property is a system parameter, the direct parameter sampling technique used in the conventional sensitivity analysis requires several hundred resolutions of the system equations. The adjoint technique requires the solution of only two system matrix equations in order to determine the sensitivity of a user-selected system performance function, to all system parameters. In the case of steady-state problems, the adjoint equations are resolved backwards in space. For transient problems, the adjoint equations are resolved backwards in both space and time. The user-selected performance functions are usually in the form of Dirac delta functions at points in space and time. In this paper the matrix equations for two-dimensional mass transport are presented. Results from a one-dimensional representation are described to show the utility of the technique. The results show that the performance measure for the chosen study area is most sensitive to porosity perturbations, followed by solute source strength perturbations. (See also W88-10912) (Cassar-PTT)
W88-10944

METHODS FOR THE SIMULATION OF POLLUTANT TRANSPORT IN GROUND WATER: A MODEL COMPARISON,
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
W. Kinzelbach.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 656-675, 16 fig, 1 tab, 15 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Solute transport, Model studies, Numerical analysis, Mathematical studies, Finite difference methods, Finite element method, Particle tracking methods, Method of characteristics model, Random walk model, Groundwater movement, Comparison studies.

Numerical solution methods available for use in groundwater pollutant transport models were compared by applying typical representatives of two-dimensional models to a number of test cases on the basis of equal discretization. The four methods were (1) an explicit finite difference model with central or upwind spatial differences (comparable to the SWIFT model; (2) a finite element model on the basis of triangular elements and linear interpolation with forward differencing in time (comparable to the SEFTRAN model); (3) the method-of-characteristics model of the U. S. Geological Survey; and (4) a random walk model based on the Prickett model of 1981 with the option of adding complete velocity terms according to the Ito-Fokker-Planck theory. Under certain conditions all models showed flaws. standard finite difference and finite element models yielded unreliable results when discretization conditions were not met. Particle tracking methods (random walk) showed oscillations and demixing problems. However, only the random walk method allowed a simple and straightforward incorporation of scaling dispersivities. Results of the random walk technique should be compared to measurements on the basis of more integral quantities such as breakthrough curves at pumping wells rather than on the basis of local concentrations. The choice of the method for a particular application should be based on the actual problem to be solved. For example, the prediction of the first arrival of a pollutant at a well demands

a method with little or no numerical dispersion. On the other hand, if only a conservative estimate of the first arrival is required, a model with some longitudinal numerical dispersion may be acceptable. (See also W88-10912) (Cassar-PTT)
W88-10945

REMEDIAL ACTIONS UNDER VARIABILITY OF HYDRAULIC CONDUCTIVITY,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 5G.
W88-10947

ANALYTICAL AND NUMERICAL SIMULATIONS OF LEACHATE MIGRATION IN UNCONFINED AQUIFERS,
GeoTrans, Inc., Herndon, VA.
P. S. Huyakorn, B. H. Lester, H. O. White, T. D. Wadsworth, and J. B. Buckley.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 727-748, 10 fig, 18 ref.

Descriptors: *Path of pollutants, *Groundwater contamination, *Leachates, *Landfills, *Solute transport, Mathematical models, Semi-analytical methods, Aquifers, Unconfined aquifers, Infiltration, Waste disposal, Simulation, Comparison studies.

The problem of leachate migration from a land disposal unit overlying an unconfined aquifer was analyzed using both simplified semi-analytical and rigorous numerical approaches. These approaches account for advective-dispersive transport of dissolved contaminants in the vadose and saturated zones of the aquifer. Adsorption and decay were represented using linear equilibrium isotherm and first-order decay constants, respectively. The semi-analytical model consisted of three components: (1) a simplified one-dimensional simulator describing steady-state vertical infiltration, (2) a one-dimensional, multilayered analytical solution describing vertical transport from the base of the land disposal unit to the water table, and (3) a three-dimensional analytical solution describing subsequent transport in a steady uniform groundwater flow field. The numerical model is a two-dimensional Galerkin finite-element model having general flexibility but requiring much greater computational effort than the analytical model. Both the composite semi-analytical and the numerical models were applied to two common scenarios involving the migration of a toxic conservative inorganic compound from a landfill and a surface impoundment. Direct comparison of simulation results obtained from both models indicates that the composite semi-analytical model provides a highly efficient tool for preliminary evaluation of the contaminant migration problem and for land disposal screening applications. (See also W88-10912) (Author's abstract)
W88-10948

SIMULATION OF GROUND WATER CONTAMINATION IN THREE DIMENSIONS,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
E. O. Frind.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 749-763, 9 fig, 1 tab, 11 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Landfills, *Leachates, *Model studies, Galerkin model, Errors, Dimensional analysis, Solute transport, Mathematical models, Plumes, Aquifers, Simulation.

The Alternating Direction Galerkin Model was applied in two and three dimensions to the simulation of a contaminant plume in order to show the errors that result from two-dimensional modeling. Results show that when the horizontal transverse dimension is neglected, as in the case of vertical cross-sectional simulation, the advance of the plume front will always be overestimated. Calibration of a two-dimensional cross-sectional model against a real plume could lead to misleading results because the characteristic three-dimensional response may be indistinguishable from that due to either an increasing dispersivity or an increasing source function. Errors due to neglecting the third dimension are found to be significant even when the transverse dispersion is small. A vertically-averaged horizontal plane model can also give misleading results because actual concentrations in some parts of the aquifer will always be higher than the vertical average, and a plume defined in terms of actual concentrations will always extend farther than a plume defined by vertical averages. If chemical reactions are involved, the actual concentrations that drive the reactions can only be provided by the three-dimensional simulation. (See also W88-10912) (Cassar-PTT)
W88-10949

WASTE CONFINEMENT PERFORMANCE OF DEEP INJECTION WELLS,
GeoTrans, Inc., Herndon, VA.
D. S. Ward, D. R. Buss, D. W. Morganwalp, and T. D. Wadsworth.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 764-781, 8 fig, 1 tab, 8 ref. EPA Contract 68-01-7011.

Descriptors: *Model studies, *Path of pollutants, *Groundwater pollution, *Solute transport, *Injection wells, *Waste disposal, Saline aquifers, Aquifers, Leakage, Mathematical models.

A numerical flow and transport model was used to simulate the potential migration of hazardous waste after injection into an aquifer over the well's 30-year operational life. The model was designed to evaluate the hydraulic response to hypothetical undetected pathways in the confining formations. Three types of undetected pathways were considered: well-related failures, abandoned unplugged boreholes, and vertical fracture/fault zones through the confining unit. The model configuration for each of four hydrogeologic settings (Texas Gulf coast, East Gulf coast, Great Lakes, and Kansas) included an injection zone, a confining zone, and several overlying aquifers of varying hydraulic properties. A sensitivity analysis was performed by varying the degree of hydraulic resistance assigned to each pathway and the location of the pathway relative to the injection well. The results indicate that the presence of pathways dominates system response despite differences in geologic framework. In only certain situations were confining units found to allow leakage of waste into overlying units If the hydraulic conductivity of the confining unit is less than 0.001 of the injection zone, then waste tends to migrate through the undetected paths. Conversely, if the conductivity is greater than 0.001, then the waste tends to leak directly through the confining unit. (See also W88-10912) (Cassar-PTT)
W88-10950

COMPUTER AIDED SITE INVESTIGATION AND MANAGEMENT: A TOOL FOR ASSESSING AND MANAGING GROUNDWATER CONTAMINATION,
Hydro Geo Chem, Inc., Tucson, AZ.
For primary bibliographic entry see Field 5G.
W88-10951

MODELING DISPERSION IN LAYERED AQUIFERS USING THE DUPUIT-FORCHHEIMER ASSUMPTION,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2F.
W88-10959

ANALYSIS OF THE VALIDITY OF ANALYTICAL MODELS USED FOR ASSESSMENT OF FORTY-FIVE WASTE SITE AREAS: SUBSURFACE FLOW AND CHEMICAL TRANSPORT,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
B. B. Looney, R. A. Field, G. B. Merrell, G. M. Duffield, and C. B. Andrews.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 954-982, 11 fig, 2 tab, 29 ref. Dept. of Energy Contract DE-AC09-76R00001.

Descriptors: *Quality control, *Model studies, *Path of pollutants, *Groundwater pollution, *Groundwater movement, *Solute transport, Analytical models, Mathematical models, Waste disposal, Subsurface flow, PATHRAE model, Vertical and horizontal spread model, Chemical speciation, Risks.

Closure actions at 45 waste sites were analyzed using an analytical model. The quality assurance program consisted of comparison to analytical solutions with different boundary conditions, comparison of model results to measured concentrations, comparison with layered numerical solutions, and evaluation and sensitivity analysis of input data. Included among the models tested were PATHRAE and EPA's VHS model (vertical and horizontal spread). In general, the results indicate that the selected model (I-D advection with longitudinal dispersion and decoupled transverse dispersion, decaying source) is a reasonable screening tool. Specifically, the results suggest that chemical speciation must be addressed to adequately predict measured concentrations; transient models that account for unsaturated zone transport predict higher peak concentrations than those predicted by the VHS model; modeling objectives (e.g., determining relative risks as a function of closure scenario) should influence model selection due to differences of assumptions and results between simple analytical solutions and more robust numerical methods. (See also W88-10912) (Cassar-PTT)
W88-10960

SEMI-ANALYTICAL METHOD FOR CONTAMINANT TRANSPORT MODELLING,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
G. L. Moltyaner.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 983-1003, 3 fig, 13 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Groundwater movement, *Solute transport, *Semi-analytical methods, *Model studies, Mathematical models, Galerkin method, Finite element method, Finite different methods, Analytical models, Dimensional analysis.

A semi-analytical method for solving partial differential equations that combines Galerkin's finite element method or finite difference method and the analytical solution method is described. The general idea behind the semi-analytical method is to reduce the dimensionality of a given differential equation so the resulting equation is suitable for solution by analytical techniques. The developed Galerkin semi-analytical method incorporates the following steps: (1) partitioning of the problem domain into elements; (2) selection of the trial solution; (3) determination of the matrix equation using the Galerkin finite-element method; (4) reduction of the coefficient matrix to diagonal form with the aid of orthogonal transformation; and (5) solution of the resultant set of independent equations using analytical techniques. The semi-analytical method of lines which is developed in this paper involves virtually the same steps but a finite difference approximation is used to reduce the order of the given partial differential equation by one. The semi-analytical method is illustrated through application to the equation governing steady-state groundwater flow in a domain with irregular geometry. The accuracy of semi-analytical solutions is examined by comparison with finite element modeling. The results of semi-analytical and numerical solutions were virtually identical. The constructed semi-analytical solution for an irregular domain was also compared with that for a rectangular domain to ensure that a constructed

analytical continuation into the irregular domain is possible. (See also W88-10912) (Author's abstract)
W88-10961

NUMERICAL MODELING OF REGIONAL GROUNDWATER POLLUTION BY TETRACHLOROETHYLENE,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
T. Furuichi, and Y. Magara.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1039-1050, 15 fig, 3 tab, 4 ref.

Descriptors: *Model studies, *Path of pollutants, *Groundwater pollution, *Organic compounds, *Chemical wastes, Tetrachloroethylene, Chlorinated hydrocarbons, Mathematical models, Solvents, Sendai Plain, Japan, Prediction, Simulation.

A mathematical model was developed for simulating and predicting the occurrence of pollution by tetrachloroethylene and to analyze the pollution data. A horizontal two-dimensional analysis was conducted. The study area was located on the west side of the Sendai Plain; it is composed of three rivers terraces of the Hirose River. The computer code SIGNAS was used for groundwater flow simulation. The distributions of tetrachloroethylene concentration were computed by the finite element method. A flow separation was found at a sewer pipe laid along a highway; it was expected that pollutant transport would be delayed at that point. (See also W88-10912) (Cassar-PTT)
W88-10964

GRID REFINEMENT APPROACH TO FLOW AND TRANSPORT MODELING OF A PROPOSED GROUND-WATER CORRECTIVE ACTION AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
GeoTrans, Inc., Herndon, VA.
G. M. Duffield, D. R. Buss, D. E. Stephenson, and J. W. Mercer.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1087-1120, 21 fig, 5 tab, 8 ref. Dept. of Energy Contract DE-AC09-76SR-00001.

Descriptors: *Radioactive waste disposal, *Path of pollutants, *Water quality control, *Groundwater movement, *Solute transport, *Model studies, Mathematical models, Savannah River Plant, Aiken, South Carolina, Waste disposal, Industrial wastes, Regional planning, Cost analysis, Computer program.

A grid refinement technique was used to simulate groundwater flow and solute transport at regional and local scales within the General Separation Area at the Savannah River Plant, Aiken, South Carolina. The regional model, calibrated by an automatic nonlinear least-squares procedure, resulted in a set of hydraulic parameter values consistent with determinations made by other methods. The automatic procedure greatly facilitated the calibration of the model in which ten hydraulic parameters were treated as unknowns. Groundwater flow velocities, calculated from the regional flow model, were used to perform particle-tracking analyses. Flow directions were compared with observed directions of flow to provide a check on the calibration of the model prior to performing solute transport modeling. Local transport models were developed for two waste disposal sites within the General Separations Area. It was necessary to reduce the area of the model domain to maintain cost and computational efficiency. Preservation of regional flow phenomena within the local model domains was accomplished by a grid refinement technique. The regional model provided boundary conditions and hydraulic parameters to the local models, allowing finite-difference mesh refinement for the transport calculations. The local transport simulations evaluated hypothetical groundwater remediation systems. The grid refinement technique in conjunction with the parameter estimation method was very effective in the analysis of regional and local flow and transport phenomena in the General Separation Area. The model calibration was not severely constrained by artificially imposed boundary conditions. The estimated hydraulic parameters, determined objectively by the automatic procedure, showed excellent agreement with results from other methods. (See also W88-10912) (Author's abstract)
W88-10967

AUTOMATED GIS FOR GROUND WATER CONTAMINATION INVESTIGATION,
Environmental Systems Research Inst., Redlands, CA.
M. Broten, L. Fenstermaker, and J. Shafer.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1143-1161, 4 fig, 6 ref, 1 append. Lockheed Engineering and Management Services Company Contract 68-03-3245.

Descriptors: *Path of pollutants, *Water quality control, *Groundwater pollution, *Groundwater movement, *Model studies, Mathematical models, San Gabriel Basin, California, Waste disposal, Data collections, Land use, Mapping, Data processing, Hydraulic conductivity, Wells, GWPATH model, Geographic Information System, Organic compounds, Data bases.

A prototype geographic information system (GIS) for management of hazardous waste and groundwater contamination problems was developed. An important component of the study was the interface of the GIS with a numerical groundwater flowpath model. The model was used to delineate potential contaminant source areas for points of known contamination in the San Gabriel Basin, California. The hydrogeological data included in the GIS were several potentiometric surfaces, specific yield, hydraulic conductivity, pumpage, geology, soils, land elevation, aquifer bottom elevation, and organic chemical sampling. A link was created between well locations and grid cells so that hydrogeologic data could readily be associated with a grid or with specific points to allow for interface with various groundwater flow and transport models. The relational data base management capabilities of the system were used to create tabular listings of data required as input to the groundwater flowpath model. Output from the model included planar coordinates defining pathlines and attributes associated with each line. These data were brought back into the GIS and used to define potential contaminant source areas. Additional data within the GIS used for overlay analyses and mapping included a detailed land use data base, locations and names of hazardous substance related activities, municipal boundaries, census tracts, water purveyor service areas, transportation network, streams, soil associations, and geology. Generic capabilities of the GIS provided for relatively simple analyses and product generation. (See also W88-10912) (Cassar-PTT)
W88-10969

TWO DIMENSIONAL MODELING APPROACH OF A MIXTURE OF COMPOUNDS FOR THE ASSESSMENT OF HUMAN AND ENVIRONMENTAL HEALTH IMPACTS,
Monsanto Co., St. Louis, MO.
C. A. Staples.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1209-1230, 6 fig, 6 tab, 6 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Groundwater movement, *Organic compounds, *Model studies, Mathematical models, Waste disposal, Solvents, Rivers, Toxicity, Aquifers, Unconfined aquifers, Shallow aquifers, Mass transport, Regulations, Equalizing basins, Chlorinated hydrocarbons, Waste treatment.

A two-dimensional modeling approach was used to evaluate movement potential within an aquifer, discharge to a river and resultant river concentrations of organic chemicals originating in a waste facility. The treatment site contained an equalization basin, an emergency basin, surge basin, limestone pit, activated sludge basins, and clarifier, with discharge into a semi-regulated river. Flow evaluations, geometry, compound mixture characteristics and loadings of the aquifer were used as data inputs to a modified random-walk model. Results suggest that the concentrations of the chemicals (a mixture of chlorobenzene and other solvents) discharging to the surface water had no discernible impact on human or environmental health. The margin of safety (toxicologically safe concentration/exposure concentration) was 2700-3600. A margin of safety greater than 1 is considered acceptable. No remediation of the aquifer was deemed necessary. However, removal of a main source of solvent loading would further improve the margin of safety. (See also W88-10912) (Cassar-PTT)
W88-10973

APPLICATION OF SENSITIVITY AND SECOND ORDER UNCERTAINTY ANALYSIS IN FORMULATING REGIONAL GROUNDWATER CONTAMINATION RISKS AND DATA SENSITIVITIES,
Kirkner and Associates, Inc., Lake Wales, FL.
M. L. Voorhees, and J. M. Rice.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1262-1288, 12 fig, 2 tab, 9 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Sensitivity analysis, *Model studies, Mathematical models, Florida, Septic tanks, Waste disposal, Wastewater treatment, ISUAP model, Risks, Nitrates, Uncertainty analysis.

A three-dimensional analytical model (Information Sensitivity and Uncertainty Analysis Program, ISUAP) was developed to study the contamination risk from residential septic tanks in Florida. A model septic tank site was formulated and subjected to uncertain model input parameters. Parameters included source size, dispersivities, hydraulic conductivity, porosity, hydraulic gradient, first order decay, retardation, and contamination source strength. Numerical quadrature was applied in formulating aerial sources and average vertical concentrations. Moments about the plume and source centroids were computed to establish the migration and potential for each region and selected constituents. First order sensitivity analysis identified parameters which had the large product of partial derivatives and regional parameter variance. Application of these procedures resulted in an objective approach in ranking hydrogeologic regions. Monte Carlo simulation provided a reliable check of uncertainty analysis results. Contamination risk was defined for eight representative hydrogeologic regions in Florida. (See also W88-10912) (Cassar-PTT)
W88-10975

USE OF PC SPREADSHEET MODELS AS A ROUTINE ANALYTICAL TOOL FOR SOLVING GROUND WATER PROBLEMS,
Highland Associates, Golden, CO.
For primary bibliographic entry see Field 2F.
W88-10979

GEOCHEMICAL REACTION MODELING IN CONTAMINANT MIGRATION STUDIES OF THE URANIUM MILL TAILINGS ENVIRONMENT,
Battelle Pacific Northwest Labs., Richland, WA.
S. R. Peterson, and W. J. Deutsch.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1353-1383, 14 fig, 4 tab, 49 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Radioactive wastes, *Plumes, *Model studies, Mathematical models, Aquifers, Industrial wastes, Spoil banks, Solute transport, Metals, Heavy metals, Trace elements, Aluminum, Calcium, Sulfates, Iron, Iron hydroxides, Adsorption, Manganese, Selenium, Zinc, Chemical speciation,

Geochemistry, Uranium, Mine wastes, Chemical reactions, Wastewater lagoons.

A computer-based conceptual model was used to predict contaminant concentrations in effluents from column experiments and in plumes migrating from a uranium mill tailings waste impoundment. The solids chosen for inclusion in the conceptual model were selected based on reviews of the literature, on ion speciation/solubility calculations performed on column effluent solutions, and on mineral characterization of the contacted and uncontacted sediments. The mechanism of adsorption included in the conceptual chemical model was chosen based on results from semi-selective extraction experiments and from mineral characterization procedures performed on the sediments. Macro constituents (for example, Ca, sulfate, Al, Fe, and Mn) of the tailings solution in both the laboratory and the field were predicted closely by considering their concentrations to be controlled by the precipitation/dissolution of solid phases. Trace elements, however, was generally predicted to be undersaturated with respect to plausible solid phase controls. The concentration of several of the trace elements were closely predicted by considering their concentrations to be controlled by adsorption onto the amorphous iron oxyhydroxides that precipitated. (See also W88-10912) (Cassar-PTT)
W88-10980

USE OF THE VERTICAL HORIZONTAL SPREAD (VHS) MODEL FOR DELISTING HAZARDOUS WASTE,
Minnesota Mining and Mfg. Co., St. Paul.
K. H. Reinert.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1384-1399, 6 fig, 1 tab, 16 ref.

Descriptors: *Model studies, *Path of pollutants, *Groundwater pollution, *Waste disposal, *Environmental protection, Landfills, Leachates, Resource Conservation and Recovery Act, Mathematical models, Regulations, VHS model, Vertical horizontal spread, Delisting petitions, Hazardous wastes.

In compliance with the Hazardous and Solid Waste Amendments of 1984 under the Resource Conservation and Recovery Act, the U.S. EPA has developed a new procedure for delisting hazardous wastes. This procedure utilizes a generic, analytical groundwater transport model (VHS model) in the decision making process. The delisting petitioner must obtain chemical measurements of various hazardous constituents in the waste leachate. The model then predicts the concentrations of these constituents at an off-site receptor point downgradient from a generic hazardous waste landfill. The VHS model utilizes a one-dimensional steady flow regime with horizontal dispersion perpendicular to the flow path. This paper examines the use of the VHS model in preparing delisting petitions of hazardous waste for landfill disposal. Seven specific inputs or assumptions are as follows: (1) receptor well or compliance point directly in the flow line, 152.4 m downgradient; (2) waste volume and dilution; (3) no attenuation zone; (4) unlined municipal landfill; (5) no site-specific data are utilized; (6) transverse dispersivity; and (7) disposal trench width. The model represents a worst case scenario. (See also W88-10912) (Cassar-PTT)
W88-10981

MODELING SORBING SOLUTE TRANSPORT THROUGH HETEROGENEOUS AQUIFERS ON A SUPERCOMPUTER,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
A. K. Valocchi, G. A. Peterson, and O. Elnawawy.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1400-1412, 4 fig, 11 ref. Grants CEE-8204434 and ECE-8418644 and U.S. Geological Survey Grant 14-08-0001-G-1299.

Descriptors: *Path of pollutants, *Groundwater pollution, *Solute transport, *Adsorption, *Plumes, *Model studies, Heterogeneity, Permeability, Mathematical models, Spatial variation, Kinetics.

A combined numerical and analytical modeling approach was used to study the effects of spatial variability and kinetics on the transport of sorbing solutes. A finite difference model based on a first-order reversible kinetic reaction submodel was constructed and validated. It was possible to include correlated hydraulic and reaction parameters with the less permeable zones showing greater sorptive capacity. Results were obtained for two-dimensional flow through perfectly stratified aquifers. Model runs were conducted on the CRAY X-MP supercomputer. Use of a supercomputer resulted in a rapid execution time, even for fine-grid meshes. The rapid turnaround was very beneficial when model runs were being run repeatedly to explore impacts of parameter changes. Model results were processed on a high-resolution color graphics work station. The analytical model assumed a two-layer stratified aquifer having homogeneous reaction parameters. The models were used to investigate the impact of kinetics on depth-averaged solute behavior. The results indicate that the relative importance of kinetics diminishes as the permeability contrast among the strata increases. (See also W88-10912) (Cassar-PTT)
W88-10982

DEVELOPMENT OF A STRUCTURED MODEL OF MICROBIAL REACTION IN GROUND WATER CONTAMINATION PROBLEMS,
Kyoto Univ. (Japan).
Y. Kurobane, and T. Furuichi.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1413-1433, 6 fig, 3 tab, 24 ref, 3 append.

Descriptors: *Fate of pollutants, *Path of pollutants, *Groundwater pollution, *Model studies, *Microorganisms, *Biodegradation, Degradation, Biomass, Mathematical models, Soil bacteria, Williams-Monod-Fredrickson model, Soil columns, Gear technique, Organic compounds, Simulations.

The structured growth model of Williams was modified to produce a model relating the microbial activity in a biomass with the cell number. This was called the Williams-Monod-Fredrickson model (WMFM). The model successfully simulated the actual microbial population behavior in a batch culture and in a soil column continuously furnished with substrate. In a sensitivity analysis WMFM simulation in a soil column was compared with different values of microbe-carrying capacity of soil (termed Mmax). Since the cell size varied in time depending on the value of Mmax, it was necessary to carefully distinguish the cell number from the biomass when comparing the soil microbial activity between different soil systems in terms of the existent microbe. In a stability analysis the response of the model to the change of dilution rate in a continuous cultivation system was investigated. Both WMFM and WMFM with time lag, unlike the parent Williams model, were stable and showed no sign of oscillations to the change of the dilution rate. The WMFM equations in batch culture were solved numerically using Gear's technique since the equations were nonlinear and showed stiffness. For the numerical solution of WMFM for soil columns, the operator splitting method was used. The equations were split into physical transport equations and biological reaction equations, the former being solved by the finite element method, the latter by Gear's technique. (See also W88-10912) (Cassar-PTT)
W88-10983

GROUND WATER FLOW MODELING AT A HAZARDOUS WASTE SITE FOR REGULATOR COMPLIANCE,
Battelle Pacific Northwest Labs., Richland, WA.
P. J. Mitchell.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 1434-1453, 17 fig, 8 ref. Dept. of Energy DE-AC06-76RLO 1830.

Descriptors: *Environmental protection, *Path of pollutants, *Groundwater pollution, *Groundwater movement, *Model studies, Mathematical models, Waste disposal, Regulations, Resource Conservation and Recovery Act, Hanford Site, Washington, Columbia River, Wells, Monitoring wells, Water level fluctuations, Water table, Finite difference methods, Surface-groundwater relations, Solute transport.

A two-dimensional finite difference groundwater flow model was developed for an unconfined aquifer underlying a hazardous waste facility at the Hanford Site near the Columbia River in Washington. Characterization of the groundwater flow system was complicated by water-table fluctuations of several feet per day. This was related to changes in the river stage produced by discharges from Priest Rapids Dam located upstream. The model was calibrated with 6 months of continuous water-level measurements from three wells and continuous river-stage data. Two-hour time steps were used in transient simulations. Measured river elevations were used during each time step as a constant-head boundary. The modeled responses at well locations showed an acceptable match with groundwater levels recorded in the field and hydraulic gradients in the vicinity of the facility. Simulations of the unconfined aquifer were made to estimate the probable paths of any transport from the facility, and recommendations were made for the placement of additional monitoring wells for regulatory compliance.(See also W88-10912) (Cassar-PTT)
W88-10984

APPLICATION AND DEMONSTRATION OF ANALYTIC ELEMENT MODELS,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 2F.
W88-10986

RESEARCH NEEDS IN VALIDATING AND DETERMINING THE PREDICTABILITY OF LABORATORY DATA TO THE FIELD,
Colorado State Univ., Fort Collins. Water Resources Lab.
For primary bibliographic entry see Field 7C.
W88-10998

AQUATIC HAZARD ASSESSMENT: PICLORAM,
Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
For primary bibliographic entry see Field 5C.
W88-11010

PHYSICAL/CHEMICAL PROPERTIES OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Monsanto Co., St. Louis, MO.
J. M. Schroy, F. D. Hileman, and S. C. Cheng.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 409-421, 2 fig, 7 tab, 19 ref.

Descriptors: *Path of pollutants, *Physical properties, *Chemical properties, *Tetrachlorodibenzo-p-dioxin, *Dioxins, *Fate of pollutants, TCDD, Soil temperature, Volatility, Vaporization.

Limited and inaccurate physical property data for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) have inhibited the development of good environmental transport and fate information for this material. Based on limited literature data and transport modeling techniques evaporation of 2,3,7,8-TCDD from the soil column was proposed as a major factor in its movement in the environment. Estimated physical properties data were used to focus field sampling and analytical work and to identify

the key physical property parameters that required quantification. The following are some of the conclusions that can be made based on the experimental work completed to-date: (1) TCDD is volatile at ambient soil temperatures; (2) TCDD vapor behaves as an ideal gas in the temperature range studied; (3) Based on a review of literature, Standard Chemical Engineering techniques for estimating physical properties are not adequate for predicting the vapor pressure for a chemical that is a solid at ambient temperature and volatilizes by sublimation. However, the liquid and vapor phase properties of the solids at temperatures above their melting points can be estimated by the standard methodologies; and (4) The heat of sublimation for TCDD is 123.91 kJ/gmole. (See also W88-10991) (Lantz-PTT)
W88-11024

ENVIRONMENTAL MOBILITY OF DIOXINS,
Monsanto Co., St. Louis, MO.
R. A. Freeman, and J. M. Schroy.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 422-439, 6 fig, 7 tab, 50 ref.

Descriptors: *Dioxins, *Model studies, *Path of pollutants, *Times Beach, *Soil contamination, *Missouri, Fate of pollutants, Soil columns, Vaporization.

A model has been developed to describe the vapor phase transport of low volatility organic chemicals in a soil column. The mathematical model finds the rate of vapor transport by solving the dynamic material and energy balance around a soil column. The model is used to make predictions on the transport of 2,3,7,8-tetrachlorodiobenzo-p-dioxin (2,3,7,8-TCDD) at the Times Beach, MO site. Based on this analysis, the following conclusions about the transport of TCDD can be reached: (1) TCDD is volatile; (2) Vaporization is one mechanism that can be used to describe the TCDD concentration profiles measured in the soil of Times Beach, MO. The transport of TCDD into and from a soil column can be described by a temperature driven process; (3) Based on a simulation of the measured concentration profile of TCDD at the end of ten years and an estimate of the initial surface concentration, it may be concluded that; (a) TCDD will volatilize from soils most rapidly during the summer months. TCDD will not volatilize from soils to any appreciable extent during the winter. (b) Over 50% of the total applied TCDD volatilized during the first summer after initial application at Times Beach. (c) Over 90% of the applied TCDD volatilized from the top 1 cm of soil during the first summer. (See also W88-10991) (Lantz-PTT)
W88-11025

BIOCONCENTRATION OF FOUR CHLORINATED DIOXINS BY RAINBOW TROUT AND FATHEAD MINNOWS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, A. L. Yarechewski, and G. R. B. Webster.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 440-454, 3 fig, 4 tab, 25 ref.

Descriptors: *Dioxins, *Rainbow trout, *Fathead minnows, *Biological magnification, *Bioaccumulation, Path of pollutants, Tetrachlorodibenzodioxin, Pentachlorodibenzodioxin, Fate of pollutants, Hexachlorodibenzodioxin, Heptachlorodibenzodioxin.

Accumulation of four 14-C-labelled chlorinated dibenzo-p-dioxins (1,2,3,7-tetrachloro- (T4CDD), 1,2,3,4,7-pentachloro- (P5CDD), 1,2,3,4,7,8-hexachloro- (H6CDD), and 1,2,3,4,6,7,8-heptachloro- (H7CDD) isomers) from water by rainbow trout fry (Salmo gairdneri) and fathead minnows (Pimephales promelas) was studied using a 5-day exposure period followed by a 24-day elimination phase. Water concentrations of these hydrophobic compounds (measured after centrifugation) ranged from 0.005 to 0.10 ng/mL during the fish exposures. Equilibrium bioconcentration factors calculated by use of a two-compartment kinetic rate model ranged from 810 for P5CDD to 2278 for H6CDD in rainbow trout and from 515 for H7CDD to 4232 for H6CDD in fathead minnows. Elimination rates of T4CDD and P5CDD isomers were similar and rapid, with half-lives of total radioactivity averaging about 2.6 days in trout fry and 3.0 days in minnows. Half-lives of total 14-C for H6CDD and H7CDD were also similar but much longer than the other two isomers averaging about 16 days in rainbows and 20 days in fatheads. Low bioconcentration by both species was attributed to the high proportion of total radioactivity in water apparently unavailable to the fish because of association with suspended and dissolved material and to poor membrane transport. (See also W88-10991) (Author's abstract)
W88-11026

MODEL FOR ESTIMATING THE LOADING RATE OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN TO THE GREAT LAKES,
Dow Chemical Co., Midland, MI. Agricultural Research Lab.
W. B. Neely.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 455-467, 2 fig, 5 tab, 24 ref.

Descriptors: *Model studies, *Pollution load, *Water pollution sources, *Great Lakes, *Tetrachlorodibenzodioxin, Monitoring, Bioaccumulation, Lake Huron, Fish.

Identifying trace contaminants in environmental samples is becoming a common occurrence. In order to complement this activity a method is needed to estimate the loading rate that is required to achieve the observed concentrations. By matching the loading rate with identified sources an assessment of their importance can be made. This study presents a framework by which loading rates can be estimated for the Great Lakes watershed. Using data and monitoring results for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) the model is illustrated, and a loading rate of 600 g/yr was determined necessary to achieve the TCDD concentrations observed in Lake Huron fish. (See also W88-10991) (Author's abstract)
W88-11027

COORDINATION OF LOCAL, STATE, AND FEDERAL AGENCIES' RESPONSE TO GROUNDWATER CONTAMINATION EPISODES,
Elkhart County Health Dept., IN. Environmental Health Div.
For primary bibliographic entry see Field 6E.
W88-11032

ANALYSIS OF WATERWELL CONTAMINATION CASE HISTORIES,
Indiana Dept. of Environmental Management, Indianapolis. Ground Water Section.
M. R. Risch, and T. W. Zollinger.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 19-35, 1 fig, 5 tab, 15 ref.

Descriptors: *Groundwater management, *Wells, *Groundwater pollution, *Case histories, *Indiana, Data storage and retrieval, Pollutants, Fuel, Solvents, Salts, Fertilizers, Water pollution sources, Leakage, Underground storage, Hazardous materials, Waste disposal, Aquifers.

The Indiana Ground Water Protection Section has developed a method for computer storage, analysis, and reporting of water-well and groundwater-contamination case-history details. System design has allowed for incorporation of the case-history records into a statewide groundwater-quality database in the future. An examination of the case histories for 84 incidents of chemical contamination of water-supply wells in Indiana between 1974 and early 1986 suggests that fuels, solvents, salt, and fertilizer are common pollutants. The prevalent sources of contamination appear to be leaking underground storage tanks, hazardous material spills, and improper disposal of hazardous wastes, although the source was not confirmed in a fifth of the cases. Most of the 367 wells that were affected utilized shallow, unconfined aquifers and the average distance from the contaminant source to these wells was less than a thousand feet. No statistically-significant relationships among the various case-history elements were apparent at the 95-percent confidence level. This may be due in part to the small number of cases that were examined and to the nature of the data were analyzed. (See also W88-11031) (Author's abstract)
W88-11033

NEW WISCONSIN GROUND WATER CENTER TACKLES NON-POINT SOURCE CONTAMINATION WITH EDUCATION,
Wisconsin Univ.-Stevens Point.
For primary bibliographic entry see Field 4B.
W88-11034

GROUND WATER MANAGEMENT IN NORTHEASTERN ILLINOIS: UPCONING OF MINERALIZED WATER IN THE MT. SIMON FORMATION,
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 2F.
W88-11038

WATER AND TRITIUM MOVEMENT IN VARIABLY SATURATED GLACIAL DEPOSITS NEAR SHEFFIELD, ILLINOIS,
Geological Survey, Urbana, IL.
For primary bibliographic entry see Field 2F.
W88-11042

APPLICATION OF SEISMIC, EM AND RESISTIVITY TECHNIQUES TO DESIGN A GROUND WATER MONITORING PROGRAM AT A LANDFILL IN NORTHWESTERN ILLINOIS.
Geotechnology, Inc., St. Louis, MO.
For primary bibliographic entry see Field 7A.
W88-11043

SOIL GAS INVESTIGATIONS FOR VOLATILE SUBSURFACE CONTAMINANTS: CASE STUDIES IN KANSAS, USA,
Tracer Research Corp., Tucson, AZ.
For primary bibliographic entry see Field 7B.
W88-11048

DESIGN AND IMPLEMENTATION OF AN EFFECTIVE SOIL GAS MONITORING PROGRAM FOR FOUR-DIMENSIONAL MONITORING OF VOLATILE ORGANICS IN THE SUBSURFACE,
IEP, Inc., Westerville, OH.
For primary bibliographic entry see Field 7A.
W88-11049

MOVEMENT OF PESTICIDES AND NUTRIENTS INTO TILE DRAINAGE WATER IN SOUTHEASTERN INDIANA,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
E. J. Kladivko, R. L. Huffman, K. M. Oates, G. E. Van Scoyoc, and F. J. Larney.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 311-323, 3 fig, 3 tab, 11 ref.

Descriptors: *Path of pollutants, *Pesticides, *Nutrients, *Tile drainage, *Drainage water, *Indiana, *Soil water, Soil types, Permeability, Leaching, Water quality, Drain spacing, Flow rates, Herbicides, Insecticides, Water table, Piezometric head, Vadose water, Sorption, Model studies, Burrows, Porosity.

A tile-drainage study was initiated in 1983 on a Clermont silt-loam soil in southeastern Indiana. This soil has high silt and low organic matter contents and is very slowly permeable. The presence of crayfish burrows and other macropores as well as the low organic-matter and clay content of the soil may allow significant leaching of agricultural chemicals to occur in spite of the low matrix conductivity. In Autumn 1985 a water-quality study was added to the tile-drainage study to quantify chemical movement through the Clermont soil. The randomized block design has two replicates and four tile spacings (5, 10, 20, and 40m). The center tile lines for the 5-, 10-, and 20m-spacing plots are instrumented at the tile outlet to measure water outflow rates and to sample water on a flow-proportional basis. Water samples are being analyzed for nutrients (N, P, K_2) and applied pesticides (atrazine, cyanazine, alachlor, terbufos, carbofuran, chloropyrifos). Soil samples are also being collected each autumn to a depth of 90 cm and analyzed by depth increment for the same chemicals. Field measurements of outflow rates, water table levels, piezometric heads, and soil-water potential and content in the vadose zone will provide data needed to model water and chemical movement through this soil. Sorption and leaching data for these pesticides on the Clermont are being obtained with batch and packed-column studies in the laboratory. Several published models for pesticide movement through soils are evaluated with the field data. (See also W88-11031) (Author's abstract)
W88-11050

USE OF MULTIPLE PATHWAY COMPUTER CODES FOR ASSESSMENT OF HEALTH EFFECTS FROM LOW-LEVEL RADIOACTIVE WASTE,
Rogers and Associates Engineering Corp., Salt Lake City, UT.
For primary bibliographic entry see Field 5C.
W88-11051

MIDWESTERN MONITORING WELL INSTALLATION AND DEVELOPMENT,
Geotechnology, Inc., St. Louis, MO.
For primary bibliographic entry see Field 7A.
W88-11055

INSTALLATION OF OBSERVATION WELLS: THE HIDDEN COSTS,
Groundwater Technology, Inc., North Ridgeville, OH.
For primary bibliographic entry see Field 7A.
W88-11057

ENHANCED NATURAL DEGRADATION OF A SHALLOW HYDROCARBON CONTAMINATED AQUIFER,
Groundwater Technology, Inc., Farmington Hills, MI.
For primary bibliographic entry see Field 5G.
W88-11060

ARMY INSTALLATION RESTORATION PROGRAM: CONTAMINATED SOIL CLEANUP OBJECTIVES FOR AN INACTIVE ARMY AMMUNITION PLANT,
Army Biomedical Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 5G.
W88-11062

GROUND WATER QUALITY MONITORING IN IOWA: NITRATE AND PESTICIDES IN SHALLOW AQUIFERS,
Geological Survey, Iowa City, IA. Water Resources Div.
P. K. B. Hunt, and M. G. Detroy.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 591-612, 11 fig, 12 tab, 22 ref.

Descriptors: *Pollutant identification, *Water quality, *Nitrates, *Pesticides, *Herbicides, *Shallow wells, *Iowa, Geologic formations, Water sampling, Chemical analysis, Nitrogen, Water quality standards, Drinking water, Atrazine, Triazine pesticides, Seasonal distribution, Groundwater management, Aquifers.

Samples from wells in Quaternary aquifers, wells less than 150 feet deep, or both, were analyzed for nitrate and selected pesticides. In water samples collected from 605 shallow wells nitrate concentrations ranged from less than 0.02 to 26.6 milligrams per liter as nitrogen. Seventeen percent of the samples had concentrations of nitrate between 5 and 10 milligrams per liter as nitrogen; 7 percent had concentrations larger than the maximum contaminant limit for public drinking water (10 milligrams per liter as nitrogen). Twenty-three percent of the samples had a detectable concentration of at least one pesticide: alachlor, atrazine, cyanazine, dicamba, metolachlor, or metribuzin. Atrazine was the most prevalent pesticide; concentrations, which ranged form 0.12 to 12.0 micrograms per liter were detected in 21 percent of the samples. Pesticide concentrations as large as 14 micrograms per liter were detected in some samples. The results of the monitoring program indicate a relation between decreasing well depth and the presence of detectable concentrations of nitrate and pesticides. Most nitrate and pesticide detection was in areas where Quaternary aquifers are the principal source of groundwater. Pesticides were detected in samples collected throughout the year; samples collected in late spring and early summer more frequently contained pesticides than the other samples. (See also W88-11031) (Author's abstract)
W88-11066

EFFECTS OF CONSERVATION TILLAGE ON GROUNDWATER QUALITY: NITRATES AND PESTICIDES.
For primary bibliographic entry see Field 4C.
W88-11067

OVERVIEW OF NITROGEN MANAGEMENT FOR CONSERVATION TILLAGE SYSTEMS: AN OVERVIEW,
Minnesota Univ. Technical Coll., Waseca.
For primary bibliographic entry see Field 4D.
W88-11070

OVERVIEW OF RURAL NONPOINT POLLUTION IN THE LAKE ERIE BASIN,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
D. B. Baker.
IN: Effects of Conservation Tillage on Groundwater Quality: Nitrates and Pesticides. Lewis Publishers, Chelsea, Michigan, 1987. p 65-91, 5 fig, 10 tab, 25 ref.

Descriptors: *Nonpoint pollution sources, *Water pollution sources, *Agricultural runoff, *Agricultural engineering, *Agricultural hydrology, *Nitrates, *Pesticides, *Great Lakes, Phosphorus, Organic pesticides, Organic compounds, Water pollution, Bed load, Seasonal variation, Storms, Sediment transport, Runoff, Watersheds, Monitoring, Rural areas, Lakes, Rivers.

An overview is presented of nitrate and pesticide contamination in the surface water of the Lake Erie Basin region, including data on sediment and phosphorous loads in the rivers of this region. Included in the discussion are Lake Erie tributary monitoring programs, material transport during storm events, annual and seasonal variability in loadings, mean annual loads, unit area loads, and sediment delivery ratios. Profiles from annual chemographs are presented, Lake Erie Basin is compared with the Chesapeake Bay Basin for river loadings of sediment, total phosphorus and total nitrogen. The tributary monitoring programs in the Lake Erie Basin indicate that area rivers transport large loads of sediments and both particulate and soluble phosphorus derived from agricultural sources. Agricultural runoff also results in riverine nitrate concentrations that frequently exceed drinking water standards. Relatively high concentrations of many currently used pesticides are also present in area streams and public water supplies during runoff events following pesticide application. The Lake Erie tributary monitoring programs also illustrate the substantial effects of watershed size on the characteristics of agricultural pollution in stream and river systems. (See also W88-11067) (Friedmann-PTT)
W88-11071

HYDROLOGIC EFFECTS OF CONSERVATION TILLAGE AND THEIR IMPORTANCE RELATIVE TO WATER QUALITY,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 4C.
W88-11073

SOIL CHEMICAL AND BIOLOGICAL PROPERTIES AS AFFECTED BY CONSERVATION TILLAGE: ENVIRONMENTAL IMPLICATIONS,
Ohio State Univ., Wooster. Agricultural Technical Inst.
For primary bibliographic entry see Field 4C.
W88-11074

EFFECT OF CONSERVATION TILLAGE ON BIOLOGICAL AND CHEMICAL SOIL CONDITIONS: REGIONAL AND TEMPORAL VARIABILITY,
Kentucky Univ., Lexington.
For primary bibliographic entry see Field 4C.
W88-11075

EFFECTS OF CONSERVATION TILLAGE PRACTICES ON PESTICIDE VOLATILIZATION AND DEGRADATION,
Agricultural Research Service, Beltsville, MD.
For primary bibliographic entry see Field 4C.
W88-11076

EFFECT OF CONSERVATION TILLAGE ON PESTICIDE DISSIPATION,
Agricultural Research Service, Beltsville, MD.
For primary bibliographic entry see Field 4C.
W88-11077

PROCESSES INFLUENCING PESTICIDE LOSS WITH WATER UNDER CONSERVATION TILLAGE,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 4C.
W88-11078

EFFECTS OF CONSERVATION TILLAGE ON PESTICIDE LOSS WITH WATER,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 4C.
W88-11079

EFFECT OF CONSERVATION TILLAGE ON FATE AND TRANSPORT OF NITROGEN,
North Carolina State Univ., Raleigh.
For primary bibliographic entry see Field 4C.
W88-11080

EFFECT OF CONSERVATION TILLAGE ON PROCESSES AFFECTING NITROGEN MANAGEMENT,
Agricultural Research Service, Lincoln, NE.
For primary bibliographic entry see Field 4C.
W88-11081

MANURE MANAGEMENT WITH CONSERVATION TILLAGE,
Cornell Univ., Ithaca, NY.

For primary bibliographic entry see Field 4C.
W88-11082

PROCEEDINGS OF THE FOCUS CONFERENCE ON SOUTHEASTERN GROUND WATER ISSUES.
National Water Well Association, Dublin, OH.
For primary bibliographic entry see Field 2F.
W88-11084

INVESTIGATION OF LEAKING UNDERGROUND STORAGE TANKS AND GROUND WATER RESTORATION IN SOUTHEASTERN FLORIDA,
CH2M Hill, Deerfield Beach, FL.
For primary bibliographic entry see Field 5G.
W88-11085

DEEP DEDICATED PUMP INSTALLATION FLORIDA EDB CONTAMINATION INVESTIGATION,
CH2M Hill, Tampa, FL.
For primary bibliographic entry see Field 5A.
W88-11087

RANDOM SAMPLE SURVEY FOR PESTICIDES: FLORIDA EXPERIENCE,
Florida State Dept. of Agriculture and Consumer Services, Tallahassee.
For primary bibliographic entry see Field 7B.
W88-11093

AGRICULTURE AND GROUND WATER QUALITY,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. A. Leonard.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 125-144, 7 fig, 3 tab, 48 ref.

Descriptors: *Groundwater pollution, *Agricultural runoff, *Water quality control, *Path of pollutants, *Mathematical models, *Pesticides, Leaching, Model studies, Surface water, Agricultural chemical.

A discussion of agricultural water use in the Southeastern United States is presented with emphasis on agricultural impacts on water quality. Technology for selecting management systems to minimize risks associated with agricultural chemical use is also addressed. The effects of agricultural management on potential chemical loading to groundwater can be evaluated using mathematical models (such as GLEAMS and CREAMS). Although no model has been shown to give very accurate predictions in terms of absolute values over a wide range of conditions, models like CREAMS and GLEAMS can be calibrated to a specific site and management system using observed data and predictions for future conditions within the range of observed data can be made. Comparative analysis using models, will assist in development of sound management strategies for protecting groundwater and surface water quality. (See also W88-11084) (Miller-PTT)
W88-11094

LANDFILL LEACHATE MIGRATION IN FLORIDA'S SURFICIAL AQUIFER SYSTEM,
Northwest Florida Water Management District, Tallahassee.
R. L. Bartel.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 164-184, 13 fig, 1 tab, 12 ref.

Descriptors: *Water pollution sources, *Aquifers, *Landfills, *Solid waste disposal, *Model studies, *Florida, *Groundwater pollution, Groundwater management, Leachates, Computer models, Hydrologic models, Parametric hydrology, Waste dumps, Clay caps, Wellpoints, Groundwater recharge.

As part of a continuing study of municipal solid waste landfills in northwest Florida, four landfills were selected for detailed investigations to determine the extent of existing or potential contamination of groundwater. An evaluation was made of the effects that commonly recommended remedial measures would have on contaminated sites. Groundwater analysis indicated limited contamination at each of these sites. Through the use of groundwater models, site conditions were simulated to evaluate their influence on the movement of contaminants. This entailed the use of two-dimensional models. Routine field sampling parameters, including specific conductance and dissolved chloride concentrations, were used for outlining the principal movements of contaminants and for preparing predictive models that included consideration of remedial measure alternatives. Computer simulations of contaminant transport indicated that uncontaminated recharge water plays a large role in the mixing or dilution process of the surficial aquifers in Florida. Recharge to the water-table aquifers occurs in abundance at the sites because of the high rates of infiltration, which are characteristic of Florida conditions. The remedial measure technologies selected included the use of clay caps, slurry walls, well-point systems and interceptor trenches. Clay caps were found to have the greatest use, but model results indicated that additional measures may be needed to keep groundwater from flowing through the buried wastes. Conclusions, based on model parameter sensitivity analysis, indicate contaminant concentrations in groundwater at some of the older sites have reached a near equilibrium condition in a relatively short time. So, the present day plumes are near the expected maximum extent of observable contamination. The approach taken is recommended for landfill owners or state regulators who may want to know the benefits realized by very costly remedial measures. (See also W88-11084) (Author's abstract)
W88-11096

CHEMISTRY OF GROUND WATERS IN THE CENTRAL FLORIDA PHOSPHATE DISTRICT,
University of South Florida, Tampa. Dept. of Geology.
S. B. Upchurch.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 201-215, 3 tab, 30 ref.

Descriptors: *Path of pollutants, *Florida, *Groundwater pollution, *Aquifer systems, *Phosphates, *Radiation, *Uranium, *Chemical properties, Chemical composition, Color, Hydrogen ion cocentration, Iron, Acidic water, Water quality, Water properties.

The natural quality of groundwaters in the central Florida phosphate mining district is summarized and some of the public concerns with respect to groundwater pollution are discussed. The four aquifer systems present in the district are lithologically dissimilar and each results in a different set of water quality conditions and problems. The surficial aquifer is characterized by acidic, organic- and iron-rich waters that frequently fail water quality standards for color, iron, pH and other parameters owing to natural processes. Gross-alpha radiation in excess of the 15 pCi/l MCL is a major problem. The gross-alpha radiation is largely a result of polonium-210. The intermediate aquifer, which includes the phosphate ore deposits, occasionally has elevated phosphorus, fluoride and radium-226, but these occurrences are widely scattered and the aquifer is seldom used. The secondary artesian and Floridan aquifers generally have high quality water. Sulfate and radium-226 may be local problems in the Floridan. Two areas can be identified as regional problems on a consistent basis: (1) interaquifer transfer of naturally contaminated surficial aquifer water to the Floridan aquifer and (2) contamination in the vicinity of agrichemical plants. Recent work indicates that the first problem is minimized by dilution, buffering, sorption on rock surfaces and radioactive decay. The second problem is restricted in extent, but it remains a major concern with extensive on-going monitoring and local remedial actions. (See also W88-11084) (Miller-PTT)
W88-11098

EXPERIMENTAL APPROACH TO DETERMINING SUBSURFACE LEAKAGE FROM A SURFACE IMPOUNDMENT USING A RADIOISOTOPE TRACER,
Oak Ridge National Lab., TN.
T. L. Ashwood, J. D. Story, I. L. Larsen, and F. J. Schultz.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 216-227, 2 fig, 4 tab, 3 ref. Department of Energy Contract No. DE-ACO5-84OR21400.

Descriptors: *Path of pollutants, *Radioactive waste disposal, *Florida, *Groundwater movement, Radioisotopes, Bromine, Sewer systems, Storm drains, Drainage systems, Tracers, Radioactive tracers, Isotopic tracers, Monitoring wells, Sursurface water.

Bromine-82, a 35.3-h half-life radionuclide, was used as a tracer to determine the paths and rates of leakage from an unlined, 1,000,000-gal (3,785,000 L) surface impoundment at the Oak Ridge National Laboratory. Since the impoundment is underlain and surrounded by storm sewer and sanitary sewer lines, known and suspected leak sites in the storm drain catch basins and sanitary sewer manholes were sampled periodically and analyzed for Bromine-82. A series of four groundwater monitoring wells were also sampled for Bromine-82. Although the catch basin and manhole samples picked up Bromine-82 in leakage from the impoundment, the monitoring well samples did not contain detectable levels of the radionuclide less than 5 hours after application of the tracer. It was concluded that the monitoring wells were sampling groundwater moving through the formation, whereas the storm drains and manholes were sampling water leaking rapidly through secondary porosity and along preferred pathways. The decline in the tracer concentration as a function of time was used to determine the residence time and flow rate of water in the pond. The flow rate, when compared with the known outflow rate, indicated that the leakage flow was small. Therefore, the main value of the test was to identify rapid leakage pathways. The experiment demonstrates the need for sampling subsurface drain systems as part of an integrated monitoring system for leakage detection. The effectiveness of Bromine-82 as a tracer for rapid leaks was also shown. (See also W88-11084) (Author's abstract)
W88-11099

GEOLOGIC AND GEOPHYSICAL CHARACTER OF FRACTURE ZONES IN A CARBONATE AQUIFER,
University of South Florida, Tampa. Dept. of Geology.
M. Stewart, and J. Wood.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 289-294, 5 ref.

Descriptors: *Florida, *Aquifer systems, *Geologic fractures, Electrical studies, Gravity studies, Diffusivity, Hydraulics, *Geophysics, Porosity.

The geologic and geophysical character of fracture zones in carbonate aquifers was studied. Two major photolinears at two field sites in west-central Florida were investigated. The sites overlie the Floridan Aquifer, a very extensive tertiary limestone aquifer system. Geophysical methods included vertical electrical soundings, horizontal electrical profiles, tri-potential arrays and microgravity. In addition, detailed soil borings were completed at each site. The data from the vertical electrical soundings provide very good information on the variation in stratigraphy and depth to rock across the fracture zone. At both sites, the principal fracture zone is distinguished by a central depression about 20 m wide. However, at one site, the central depression is within a wider, V-shaped depression. At the other site, the fracture zone is flanked by low ridges on the bedrock surface. The tri-poten-

tial arrays detected individual fractures which were confirmed by the soil borings. Both the gravity and electrical data suggest that there is a 20-30% reduction in bulk porosity of the limestone in a 50-80 m wide zone centered on the principal fracture system. This decrease in bulk porosity can be expected to increase the hydraulic diffusivity of the fracture zone and reduce the transverse dispersivity which may lead to high velocity, low dispersivity contaminant transport through the principal fracture systems. (See also W88-11084) (Author's abstract)
W88-11103

SURFACE-GEOPHYSICAL INVESTIGATIONS AT THE NORTH HOLLYWOOD DUMP, MEMPHIS, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
M. W. Bradley.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 324-343, 12 fig, 11 ref.

Descriptors: *Tennessee, *Groundwater pollution, *Superfund sites, *Landfills, *Waste disposal, Domestic wastes, Industrial wastes, Municipal wastes, Leaching, Conductivity, Resistivity, Clays, Alluvial deposits, Direct current resistivity, Terrain-conductivity methods, Geohydrology.

Two surface-geophysical methods, direct current resistivity and terrain-conductivity, were used to identify areal and vertical zones in the possible contaminated water table aquifer near the North Hollywood Dump. The site, initially used for domestic waste disposal and later as a municipal and industrial landfill, is the highest priority Federal Superfund site in Tennessee. Surface-geophysical methods cannot determine the occurrence of organic compounds but can indicate the presence of groundwater containing relatively high dissolved solids concentrations that may be associated with contamination from waste material. Direct-current resistivity soundings were used to delineate the contact between alluvial deposits and underlying clay and to identify the possible zones of contamination within the sands. Apparent resistivities for clay beneath the dump range from 10 to 26 ohm-meters. Apparent resistivities of sands measured about 70 to 290 ohm-meters, but apparent resistivities of sand in some localized areas were typically < 30 ohm-meters. The lower values may be due to the presence of groundwater with higher dissolved-solids concentrations leached from the landfill. Terrain-conductivity methods indicate areal and vertical zones of possible contamination. Apparent conductivities were generally less than 30 millimhos/m in uncontaminated areas and as much as 80 millimhos/m in contaminated areas. Based on these results, contamination has apparently migrated into the sands below the waste and toward the north and northwest. Based on geoelectric contrasts, areas to the south and east of the dump do not appear to have been affected by contaminant migration. (See also W88-11084) (Miller-PTT)
W88-11107

SURFACE-GEOPHYSICAL INVESTIGATIONS IN MELTON VALLEY, OAK RIDGE RESERVATION, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
P. Tucci.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 344-374, 16 fig, 1 tab, 17 ref.

Descriptors: *Path of pollutants, *Tennessee, *Groundwater pollution, *Waste disposal, *Underground waste disposal, *Radioactive waste disposal, Resistivity, Conductivity, Direct current resistivity, Terrain-conductivity methods, Geohydrology, Groundwater movement.

Surface-geophysical methods were valuable for refining knowledge of the geohydrology of Melton Valley, an area used for the burial of low-level radioactive waste at the Oak Ridge Reservation in Tennessee. The valley is characterized by locally complex geologic structures of interbedded shale and limestone. Radionuclides have been transported from the burial area by groundwater along flow paths that are, in part, controlled by geologic structure and type. Direct-current resistivity soundings were used to determine the depth of bedrock and to aid in the delineation of subsurface stratigraphy. Depth to bedrock, as indicated by an increase in resistivity in the interpreted geoelectric layering, was compared to auger-hole data at five sites where bedrock depths ranged from 8 - 31 ft. Differences between interpreted and reported depth to bedrock ranged from 1 to 14 feet and were within 3 ft at four sites. The subsurface contact between shale and limestone was indicated by an increase in model-calculated resistivity from < 100 to > 150 ohm-meters at four different sites. Terrain-conductivity profiles were used to aid in mapping surficial geologic contacts between shale and limestone units. Terrain conductivity for shale at 33-ft coil separation was generally > 15 millimhos/m and ranged from 10 - 40 millimhos/m. Conductivity for limestone was generally < 15 millimhos/m and ranged from 5 - 25 millimhos/m. Azimuthal conductivity surveys indicated that conductivity was greatest when the transmitter and receiver coils were oriented parallel to strike. This anisotrophy in terrain conductivity shows the need to keep coil orientation consistent throughout the length of a profile. (See also W88-11084) (Author's abstract)
W88-11108

TIME DOMAIN ELECTROMAGNETIC (TDEM) EXPLORATION FOR CHARACTERIZATION OF INJECTION ZONES AND SALT WATER INTRUSION MAPPING,
Earth Technology Corp., Golden, CO.
P. Hoekstra, and L. Evans.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 388-404, 17 fig, 1 tab, 1 ref.

Descriptors: *Aquifers, *Geologic mapping, *Geological surveys, *Well logs, *Saline water intrusion, Saline-freshwater interface, Resistivity, Time domain electromagnetic exploration.

On the basis of 150 measurements, the application and limitations of Time Domain Electromagnetic soundings for mapping fresh water-salt water interfaces and the presence of high porosity, brine-saturated strata in sedimentary sections are discussed. Time Domain Electromagnetic soundings are an electrical geophysical method used to determine the electrical resistivity stratification of the ground. Because electrical resistivity of formations is greatly influenced by dissolved solids in pore water, electrical methods are clearly the geophysical technique to be used. The following questions are considered: (1)What is the accuracy of the geophysical survey in determining the depth to the fresh water-salt water interface, (2) Can the concentration of dissolved solids be derived from geophysical surveys, (3) Is the method effective when there is a gradual increase in salinity with depth rather than an abrupt change, and (4) Will the method work equally well in all geologic settings or are the case histories shown exceptionally simple situations. In general, Time Domain Electromagnetic methods are shown to assist groundwater exploration in the Floridan aquifer effectively. (See also W88-11084) (Miller-PTT)
W88-11110

TERRAIN CONDUCTIVITY AS A TOOL FOR DELINEATING HYDROCARBON PLUMES IN A SHALLOW AQUIFER -- A CASE STUDY,
Woodward-Clyde Consultants, Tallahassee, FL.
For primary bibliographic entry see Field 7B.
W88-11111

INDUCED RECHARGING AND CONTAMINATION SUSCEPTIBILITY OF THE FLORIDAN AQUIFER, HILTON HEAD ISLAND, SOUTH CAROLINA,
South Carolina State Dept. of Health and Environmental Control, Columbia.
For primary bibliographic entry see Field 2F.
W88-11117

FINITE-ELEMENT SIMULATION MODEL FOR SATURATED-UNSATURATED FLUID DENSITY-DEPENDENT GROUNDWATER FLOW WITH ENERGY TRANSPORT OR CHEMICALLY-REACTIVE SINGLE-SPECIES SOLUTE TRANSPORT,
Geological Survey, Reston, VA. Water Resources Div.
C. I. Voss.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 84-4369, 1984. 409p, 40 fig, 19 ref.

Descriptors: *Simulation analysis, *Computer models, *Mathematical models, *Finite element method, *Saturated flow, *Unsaturated flow, *Groundwater movement, *Path of pollutants, *Saline water intrusion, Aquifers, Thermal plumes, Solute transport, Chemical reactions, Plumes, Energy transport, Sorption, Dispersion, Integrated-finite difference method, Variable-density flow.

SUTRA (Saturated-Unsaturated Transport) is a computer program which can be used to simulate the movement of fluid and the transport of either energy or dissolved substances in a subsurface environment. The model employs a two-dimensional hybrid finite-element and integrated-finite-difference method to approximate the governing equations that describe the two interdependent processes that are simulated by SUTRA: (1) fluid density-dependent saturated or unsaturated groundwater flow, and either (2a) transport of a solute in the groundwater, in which the solute may be subject to: equilibrium adsorption on the porous matrix, and both first-order and zero-order production or decay, or, (2b) transport of thermal energy in the groundwater and solid matrix of the aquifer. SUTRA provides, as the primary calculated results, fluid pressures and either solute concentrations or temperatures, as they vary with time, everywhere in the simulated subsurface system. SUTRA may also be used to simulate simpler subsets of the above process. SUTRA may be employed for areal and cross-sectional models of saturated groundwater flow systems, and for cross-sectional models of unsaturated zone flow. Solute transport simulation using SUTRA may be used to simulate natural or man-induced chemical transport, solute sorption, production and decay. SUTRA may be used for simulation of variable density leachate movement, and for cross-sectional simulation of salt-water intrusion in aquifers at near-well or regional scales, with either dispersed or relatively sharp transition zones between fresh water and salt water. SUTRA energy transport simulation may be employed to model thermal regimes in aquifers, subsurface heat conduction, aquifer thermal energy storage systems, geothermal reservoirs, thermal pollution of aquifers, and natural hydrogeologic convection systems. (USGS)
W88-11120

GROUND WATER FLOW AND CONTAMINANT TRANSPORT ANALYSIS IN GLACIALLY DEPOSITED FINE-GRAINED SOILS: A CASE STUDY,
Hart Crowser, Inc., Seattle, WA.
D. Rathnayake, D. H. Fujita, and C. C. Stanley.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 125-151. 15 fig, 3 tab, 9 ref.

Descriptors: *Path of pollutants, *Oil wastes, *Washington, *Leachates, *Groundwater movement, *Glacial drift, Permeability, Vertical flow, Case studies, *Geohydrology, Pollutants, Soil texture, Hazardous materials, Groundwater pollution, Oil industry, Aquifer testing, Monitoring.

A Resource Conservation and Recovery Act ground water monitoring program has been developed for a hazardous waste (land treatment) site at a petroleum refinery located in northwestern Washington. The site primarily consists of glacially

deposited, layered, and complexly interbedded clay, silt, and sand. Interpretation of the geology revealed the presence of three aquifers (waterbearing zones) beneath the site. These aquifers could potentially be contaminated from the leachate possibly produced from surface activities at the site. The purpose of the monitoring program is to detect the earliest potential off-site migration of contaminants through these aquifers. The major result of our work involved the proper identification and understanding of the term 'aquifer' in relation to the ground water monitoring issues at this site. The definition of 'aquifer' in a regulatory sense excludes any direct reference to the relative permeability of the geologic material in the formation. The results of our work, however, show when there was no restriction on the relative permeability in the definition of an aquifer formation, important technical aspects of a hydrogeologic analysis, such as vertical flow, were overlooked. When the vertical flow characteristics at the site are not considered, appropriate monitoring well locations cannot be selected. Our work demonstrated the importance of the vertical flow component in designing a technically competent ground water monitoring program in the complex geologic setting at this land treatment facility. (See also W88-11121) (Author's abstract)
W88-11128

PREDICTING PLUME CHARACTERISTICS FROM PUMPING WELL CONCENTRATIONS USING A ONE-DIMENSIONAL ANALYTICAL SOLUTION,
Hydrosystems, Inc., Falls Church, VA.
L. R. Silka.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 329-347. 6 fig, 3 tab, 15 ref.

Descriptors: *Plumes, *Mathematical analysis, *Path of pollutants, *Groundwater pollution, *Groundwater movement, Time series analysis, Pump wells, Well data, Prediction.

Two analytical solutions are presented for interpretation of the concentrations of a contamination at a pumping well. The first analytical solution is a simple equation for estimating the maximum concentrations that would be expected at a pumping well given the distance from the source to the well, the width of the source perpendicular to the flow direction to the well, and the concentration at the source. The second analytical solution is Bear's equation, modified for application to the interpretation of variations in contaminant concentration in produced water at a pumping well. The analytical solution provides the means to evaluate the approximate extent and distance to the original, pre-pumping plume of contaminated ground water. The analytical solution is applied to the interpretation of data collected at two Superfund sites in Washington State. Both sites are located near Tacoma, Washington. Also, the aquifer for both sites is utilized for municipal drinking water and was discovered to be contaminated by halogenated aliphatics in 1981. In each case, the modified Bear solution provides the means to interpret the concentration-versus-time date for the producing well and estimate the size of the pre-pumping plume, the distance to the center of the ideal, cylindrical plume, the approximate distance to the nearest edge of the plume, and the average concentration of the plume. (See also W88-11121) (Author's abstract)
W88-11138

CONTAMINANT EVALUATION OF THE DUWAMISH RIVER VALLEY, SEATTLE, WASHINGTON,
Converse Consultants, Inc., Seattle, WA.
J. C. Bruton, and S. R. Sagstad.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 349-362. 2 tab, 2 fig, 2 ref.

Descriptors: *Water pollution sources, *Pollutants, *Pipelines, *Groundwater pollution, *Municipal wastewater, *Soil contamination, Soil tests, Contamination, Duwamish River, Seattle Washington.

The alignment selected for the Renton Effluent Transfer System by the Municipality of Metropolitan Seattle (Metro) extended through the industrialized section of the Duwamish River Valley, in Seattle, Washington. The pipeline alignment was approximately twelve miles long and consisted of 96-inch diameter pipe installed by both cut and cover, and tunnel techniques. A detailed evaluation of soil and groundwater contamination along the pipeline alignment was completed. Due to the length of the alignment, chemical testing was performed in a staged approach that proved to be an effective tool. Concentrations and distribution of contamination were found to be below dangerous levels along the alignment in the Duwamish River Valley. (See also W88-11121) (Author's abstract)
W88-11139

MONITORING SURFACE SOIL GAS FOR DELINEATING GROUND WATER CONTAMINATION BY PETROLEUM,
Idaho Div. of Environment, Boise.
For primary bibliographic entry see Field 5A.
W88-11140

DESIGN OF LYSIMETER LEAK DETECTOR NETWORKS FOR SURFACE IMPOUNDMENTS AND LANDFILLS,
In-Situ, Inc., Laramie, WY.
For primary bibliographic entry see Field 7A.
W88-11141

ESTIMATING AIR, WATER AND HYDROCARBON CONDUCTIVITY OF SOILS FROM FIELD MEASURABLE PROPERTIES,
Soil and Material Engineers, Cincinnati, OH.
For primary bibliographic entry see Field 2G.
W88-11143

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART I. CONCEPTUALIZATIONS,
Oregon Graduate Center, Beaverton.
For primary bibliographic entry see Field 7B.
W88-11144

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART II. CASE HISTORIES,
Oregon Graduate Center, Beaverton.
For primary bibliographic entry see Field 7B.
W88-11145

GROUNDWATER POLLUTION POTENTIAL OF AIR FORCE INSTALLATIONS ON GLACIAL, ALLUVIAL, AND BASALT DEPOSITS OF THE NORTHWEST -- WASHINGTON, OREGON, AND IDAHO,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
J. K. Yu, and R. C. Wooten.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 505-525. 11 fig, 12 ref.

Descriptors: *Water pollution sources, *Groundwater pollution, *Airports, *Air force bases, *Geohydrology, *Environmental effects, Glacial soils, Alluvial soils, Basalts, Aromatic compounds, Organic compounds, Liquid wastes, Organic wastes, Washington, Oregon, Idaho.

Groundwater pollution studies have been performed at McChord AFB, Pierce County, Washington; Kingsley Field, Klamath County, Oregon; and Mountain Home AFB, Elmore County, Idaho. McChord AFB is situated on a shallow (depth of water, 5-15-feet), recessional, outwash gravel aquifer underlain by Vashon Till and Esperance Sands. The Esperance Sands is the major aquifer of the county. Kingsley Field overlies the Lower Klamath Lakebed of low permeability lacustrine sands, silts, and clays. Depths to water varied from 2-10 feet. Mountain Home AFB rests upon a 10-20 foot dry alluvium. Underneath the alluvium is the basalts of the Idaho Group. Depth to the sole-source basalt aquifer is about 350 feet from the land surface. Typical sources for potential groundwater pollution found on Air Force Bases are: (1) fuel spill/leak areas, (2) fire training areas, (3) landfills, (4) liquid waste disposal/chemical burn pits, (5) entomology shops, and (6) transformer storage areas. The most frequently occurring pollutants are the purgeable aromatic and halogenated compounds. According to an earlier report, the DRASTIC index for McChord AFB should be 122; for Kingsley Field, 105; and for Mountain Home AFB, 156. The higher the index, the greater the groundwater pollution potential. In comparison with the DRASTIC, field studies indicate that McChord AFB groundwater pollution potential is the highest, while Mountain Home AFB is the lowest. (See also W88-11121) (Author's abstract)
W88-11147

CHEMICAL TRACERS OF POLLUTION PLUMES FROM SEPTIC SYSTEMS RECEIVING TWO TYPES OF DETERGENTS,
Wisconsin Univ.-Madison. Water Chemistry Program.
B. J. Alhajjar, J. M. Harkin, and G. Chesters.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 527-555. 5 fig, 10 tab, 33 ref. Bureau of Reclamation Contract No. 14-34-0001-0257.

Descriptors: *Path of pollutants, *Tracers, *Environmental tracers, *Groundwater pollution, *Plumes, *Septic wastewater, *Detergents, *Monitoring, Phosphates, Carbonates, Statistical analysis, Comparison studies.

For two years, two groups of new septic systems in coarse-textured soils overlying shallow ground water were monitored to determine contaminations of ground water caused by the use of phosphate-(PO4) or carbonate-(CO3)-built detergents. In the shallow aquifers the distribution of detergent residues, nutrients and other chemicals were examined in efforts to trace contaminant plumes from the septic systems. The data were evaluated statistically and an contaminant transport model was tested to simulate ground water contamination for a five-county region. Detergent residues--measured as methylene-blue active substances and by fluorescence--did not pass undecomposed through the septic systems. These two measures as well as temperature and pH were unacceptable tracers of plumes of contamination from septic systems; chloride, electrical conductivity and sodium were acceptable. Neither detergent allowed entry of total phosphorus to ground water in concentrations > 0.1 mg/L. However, total nitrogen was removed more efficiently from systems receiving PO4-built than CO3-built detergents. The total nitrogen transported to ground water was largely nitrate and occurred in concentrations of 39 and 69 mg/L with PO4- and CO3-built detergent use, respectively. (See also W88-11121) (Author's abstract)
W88-11148

SUBSURFACE TRANSPORT OF GASOLINE-DERIVED LEAD AT A FILLING-STATION CONTAMINATION SITE IN YAKIMA, WASHINGTON,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
W. Fish.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 557-567. 3 fig, 2 tab, 6 ref. USGS Grant 14-08-0001-A0410.

Descriptors: *Path of pollutants, *Soil contamination, *Gasoline, *Lead, *Groundwater pollution, Underground structures, Adsorption, Groundwater movement, Aquifer testing, Washington State.

The subsurface migration of lead was studied at a field site in Yakima, Washington at which a large volume of leaded gasoline had leaked into ground water from the underground storage tanks of a filling station. Samples drawn from twenty water-table monitoring wells revealed that gasoline-de-

rived lead has migrated more than 300 ft downgradient of the source over a period of approximately seven years. Calculations based on the simple adsorption of Pb(++) to common aquifer materials predicted strong Pb sorption. Analyses of lead sorbed to fine-grained aquifer materials taken from the wells indicated that the solid phase contains several thousand times as much Pb as the dissolved (mobile) phase. However, the partition coefficients calculated from the data varied widely from 25 to over 13,000, a variation that is inconsistent with any simple adsorption or ion-exchange model. Instead it appears that dissolved Pb concentrations may be controlled by the precipitation of PbCO3. Calculation of the retardation factors associated with the strong, solid-phase association of the Pb (R sub d = 136-72,500) predicted a maximum Pb-front migration of only a few feet. The apparent paradox of precipitation or strong sorption coupled with extensive transport can be explained by either the movement of fine-colloidal, Pb-bearing, particles through the aquifer, or the the initial transport of lead as non-sorbing alkyl-lead species, followed by degradation of these mobile species into highly sorbed Pb(++). (See also W88-11121) (Author's abstract)
W88-11149

IRRIGATION IMPACT ISSUES AT THE PROPOSED GRANT COUNTY WASTE MANAGEMENT SITE,
Hart Crowser, Inc., Seattle, WA.
For primary bibliographic entry see Field 5E.
W88-11150

RURAL LANDFILL SITE CHARACTERIZATION, PUBLIC HEALTH ASSESSMENT AND REMEDIAL ACTION, KING COUNTY, WASHINGTON,
Sweet, Edwards and Associates, Inc., Redmond, WA.
For primary bibliographic entry see Field 5E.
W88-11152

VAPOR EXTRACTION OF ORGANIC CONTAMINATION FROM THE VADOSE ZONE: A CASE STUDY,
Kleinfelder (J.H.) and Associates, Sacramento, CA.
For primary bibliographic entry see Field 5G.
W88-11153

UNIQUE CLEANUP SOLUTION TO POLYCYCLIC AROMATIC HYDROCARBON CONTAMINATION FROM A 19TH CENTURY COAL GASIFICATION PLANT,
Hart Crowser, Inc., Seattle, WA.
For primary bibliographic entry see Field 5G.
W88-11154

STATISTICAL ASPECTS OF DESIGNS FOR STUDYING SOURCES OF CONTAMINATION,
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
For primary bibliographic entry see Field 7A.
W88-11161

PROCEEDINGS OF THE ASSOCIATION OF GROUND WATER SCIENTISTS AND ENGINEERS SOUTHERN REGIONAL GROUND WATER CONFERENCE.
For primary bibliographic entry see Field 2F.
W88-11182

RECHARGING RELATIONSHIPS AND CONTAMINATION SUSCEPTIBILITY OF FRACTURED CRYSTALLINE-ROCK AQUIFERS IN THE PIEDMONT AND BLUE RIDGE PROVINCES OF SOUTH CAROLINA,
South Carolina State Dept. of Health and Environmental Control, Columbia.
P. A. Stone, S. L. Clark, and T. D. Mathews.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 67-87, 62 ref.

Descriptors: *Groundwater pollution, *Groundwater recharge, *Crystalline rocks, *Path of pollutants, *Fate of pollutants, Wells, Flow velocity, Porosity, Filtration, Absorption, Dilution, Biodegradation, Tritium, Carbon radioisotopes, Dissolved solids, South Carolina, Aquifers, Groundwater movement, Hydrographs, Pumping tests, Radioisotopes, Contamination.

Fractured rock aquifers at many sites in South Carolina are highly vulnerable to rapid contamination indicated by well-contamination incidents, pumping-test evidence for local recharging, and nuclear-weapons rainout tritium in well water. For generalized management purposes the piedmont and Blue Ridge provinces in their entireties should be considered as major recharge areas. Even stream valley interiors, which normally act as discharge areas and which are considered promising for groundwater development when associated with fracture traces, may under pumped conditions recharge the fractured rock aquifers. Susceptibility of fractured rock aquifers to contamination is accentuated by low total porosities and large conduit sizes, which result in high flow velocities, reduced contact times with reactive or adsorptive geologic materials, and minimal filtration of particles (especially microbes). This susceptibility is ameliorated where the regolith overlying the rock at recharge points is simultaneously relatively thick, very finely porous, and without relict fractures or other highly permeable conduits. Where recharge water passes through a finely granular regolith, attenuation of contaminants is expected, through filtration, biodegradation, absorption, and dilution (by diffusion). Among investigated wells, 2 of 4 with radioisotope data show the presence of modern tritium (i.e. post-1953). Both wells appear to extract a mixture comprised of groundwater of widely different ages judged by moderate depletion of carbon-14 coupled with enrichment in tritium. Both radioisotope activities in one of these samples, from a distinct area of high total dissolved solids content, are not compatible with an ancient relict nature for this relatively mineralized water and the aquifer cannot be interpreted to be isolated from the surface and secure from surface-derived contaminants. (See also W88-11182) (Author's abstract)
W88-11187

WASTE MANAGEMENT AND GROUND WATER MONITORING PRACTICES: A COMPARISON OF TECHNIQUES IN THE BEAUMONT FORMATION, TEXAS CITY, TEXAS,
Texas Water Commission, Austin.
For primary bibliographic entry see Field 5E.
W88-11189

CLASS V INJECTION WELL INVENTORY AND ASSESSMENT, TEXAS,
Texas Water Commission, Austin.
For primary bibliographic entry see Field 5E.
W88-11190

HYDROGEOLOGICAL PROBLEMS ASSOCIATED WITH SITING INJECTION WELLS IN SOUTHERN LOUISIANA,
Underground Resource Management, Inc., Austin, TX.
For primary bibliographic entry see Field 5E.
W88-11191

USE OF DRIVEN CASING TO SAMPLE MULTIPLE SHALLOW WATER-BEARING ZONES IN THE GULF COAST,
Davis (Ken E.) Associates, Baton Rouge, LA.
For primary bibliographic entry see Field 5A.
W88-11192

TECHNIQUE USED TO DRILL MONITORING WELLS AT A HAZARDOUS WASTE SITE,
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 5A.
W88-11193

INSTALLATION OF OBSERVATION WELLS ON HAZARDOUS-WASTE SITES IN KANSAS USING A HOLLOW-STEM AUGER,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5A.
W88-11194

ASSESSMENT OF INFLUENCE OF COMPLEX HYDROGEOLOGIC AND GEOCHEMICAL CONDITIONS ON RCRA GROUND WATER MONITORING RESULTS,
IT Corp., Houston, TX.
For primary bibliographic entry see Field 5A.
W88-11195

EXAMPLE OF THE INFLUENCE OF DEGREE OF CHLORINATION ON SUBSURFACE MIGRATION OF POLYCHLORINATED BIPHENYLS AND RELATED COMPOUNDS,
IT Corp., Houston, TX.
D. E. Reece, and R. I. Chapin.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 218-225, 2 tab, 4 ref.

Descriptors: *Water pollution sources, *Groundwater pollution, *Polychlorinated biphenyls, *Chemical wastes, *Path of pollutants, Polychlorinated dibenzofurans, Oil refineries, Subsurface migration, Toxicity, Bioaccumulation, Contamination, Chlorinated hydrocarbons.

An abandoned factory in the Houston, Texas vicinity was used, at various times, for the manufacture of biphenyls, polychlorinated biphenyls (PCBs) as an intermediate, phenyl phenol, naphtha and fuel oils. A number of contaminants, including PCBs, polychlorinated dibenzofurans, polynuclear aromatics, solvents, and petroleum have been detected in waste residues, soil and shallow groundwater at the site. The site is drained by a flood control channel along the eastern boundary of the site. Aquatic and benthic samples collected from the channel adjacent to the site have detectable PCBs while samples collected upstream of the site have not contained detectable PCBs. Recent removal actions removed most of the surface contamination and have reduced the short term risk to the environment. Potential for future horizontal and vertical migration in the groundwater pathway is a primary factor in evaluating alternative long-term remedial action. The migration in the subsurface as well as the bioaccumulation and toxicity of PCBs are influenced by the number and arrangement of chlorine atoms attached to the biphenyl rings. Similarly, the migration of polychlorinated dibenzofurans in the subsurface is expected to be influenced by the degree of chlorination. (See also W88-11182) (Author's abstract)
W88-11198

PREDICTING NON-IONIC ORGANIC CHEMICAL SORPTION AND ATTENUATION IN SOLVENT-WATER SOIL SYSTEMS,
Monsanto Co., St. Louis, MO.
C. A. Staples.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 339-346, 1 fig, 2 tab, 9 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Organic compounds, *Sorption, *Path of pollutants, Kepone, Methanol, Ethanol, Propanol, Butanol, Methylene chloride, Mathematical models, Soil water, Soil chemistry, Solute transport.

A series of sorption tests were performed using Kepone, a 0.6% organic carbon soil and a series of solvents (methanol, ethanol, 2-propanol, butanol and methylene chloride). Solvent concentrations were at or less than their aqueous solubility. Results show significant reductions in Kepone soil partition coefficients with higher levels of solvents.

The general governing mathematical principles demonstrate the relationships between soil partition coefficients, retardation factors and predictive solute transport models. Reduction of non-ionic solute soil sorption reflects reduction in subsurface retardation factors. These reduced retardation factors are then applied to solute transport mathematical models to predict solute movement in groundwater. Predicted solute transport velocities in groundwater will therefore be enhanced by increasing levels of solvents entering the subsurface system with the solute. (See also W88-11182) (Author's abstract)
W88-11205

LEAKING UNDERGROUND STORAGE TANKS: WHAT IS REQUIRED; WHAT IS REALISTIC,
IT Corp., Houston, TX.
For primary bibliographic entry see Field 5G.
W88-11206

INDUSTRY'S RESPONSE TO L.U.S.T. REGULATIONS IN FLORIDA AND RECOMMENDATIONS FOR APPLICATION OF AVAILABLE TECHNOLOGIES,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W88-11207

STUDY OF GROUND WATER FROM AN AGRICULTURAL AREA,
Alabama Univ., University.
G. P. Whittle, and F. W. Blickle.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 401-409, 2 fig, 13 ref.

Descriptors: *Water analysis, *Groundwater pollution, *Nonpoint pollution sources, *Herbicides, *Path of pollutants, Hazardous materials, Ion chromatography, Electron capture gas chromatography, Alabama, Contamination, Pollutant identification.

Seven key factors dealing with the contamination potential of a groundwater from non-point source application of pesticides were identified and qualitatively assessed in a field study of a cotton farm in Tuscaloosa County, Alabama. Groundwater samples were analyzed for three commonly used herbicides using ion chromatography and electron capture-gas chromatography. Inductively coupled atomic plasma analysis was used to confirm the results. Although the herbicides were not detected in the groundwater, the application of contamination potential factors can be used to explain the absence of herbicide pollution. In addition, the analytical procedures employed illustrate a time-saving and sensitive method for water analysis. (See also W88-11182) (Author's abstract)
W88-11210

MIGRATION OF CHLORINATED HYDROCARBONS IN GROUNDWATER,
City Coll., New York. Dept. of Civil Engineering.
M. Y. Corapcioglu, and M. A. Hossain.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 33-52, 10 figs, 19 refs. NSF Grant CEE-8401438, American Chemical Society/The Petroleum Research Foundation PRF 15890-AC5.

Descriptors: *Path of pollutants, *Chlorinated hydrocarbons, *Groundwater pollution, *Aquifer management, *Unconfined aquifers, Plumes, Model studies, Simulation, Vertical flow, Groundwater movement, Density, Trichloroethylene.

Groundwater contamination by chlorinated hydrocarbons such as TCE, TCA, PCE and carbontetrachloride, has become a nationwide problem. In contrast to light hydrocarbons that float on the water table, dense hydrocarbons sink into the aquifer and remain on the bottom for extended periods of time. This paper studies the migration of a high-density hydrocarbon in an unconfined aquifer. The Buckley-Leverett approach is extended to a two-dimensional case to simulate a high-density immiscible hydrocarbon displacing groundwater in a gravity-driven natural gradient aquifer. Governing equations are solved by modifying software developed by Konikow and Bredehoeft at the U.S. Geological Survey. The modifications incorporated the fractional flow curves of water and their saturation derivatives in vertical and horizontal directions as functions of degree of water saturation. Results show that high-density, low-viscosity immiscible chlorinated hydrocarbons can travel deeper and further in contrast to lower-gravity largely uncoupled from the horizontal component until the plume reaches the lower boundary. Finally, a laboratory demonstration of TCE plume migration in a plexiglass flume is presented. (See also W88-11213) (Author's abstract)
W88-11216

DEVELOPMENT AND VALIDATION OF THE UNDERGROUND LEAK TRANSPORT ASSESSMENT MODEL (ULTRA),
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 7B.
W88-11217

BIOLOGICAL FATE OF HYDROCARBONS AT AN AVIATION GASOLINE SPILL SITE,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
B. H. Wilson, B. E. Bledsoe, J. M. Armstrong, and J. H. Sammons.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 78-90, 1 fig, 5 tab, 13 ref. U.S. Air Force Interagency Agreement RW57930615-01-1.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Gasoline, *Hydrocarbons, *Chemical processes, *Biodegradation, Potable water, Plumes, Microbial degradation, Petroleum products, Michigan, Airports, Alkylbenzenes.

The fate of four alkylbenzenes commonly found dissolved in ground water as a result of contamination by petroleum products was studied in aquifer material from an aviation gasoline spill site at the U.S. Coast Guard Air Station at Traverse City, MI. Contamination occurred when a flange failed on an underground storage tank. Dissolution of the alkylbenzenes from the spilled gasoline by the ground water created a contamination plume extending from the Air Station out into the East Arm of Grand Traverse Bay. Numerous private drinking-water wells were impacted. Total alkylbenzene concentrations near the center of the plume were approximately 30 mg/L. To confirm field evidence of biological transformations of the alkylbenzenes, the geochemical disposition of the organic pollution and the important electron acceptors for microbial metabolism were determined, and aquifer material from the site was acquired for laboratory studies of biological degradation. The behavior of benzene, toluene, o-xylene, and m-xylene was studied in the aquifer material. The aquifer material obtained for study came from a transect extending from the heart of the plume into pristine material. The heart of the plume contained high concentrations of methane and the alkylbenzenes and no detectable oxygen. The heart of the plume was surrounded by an anaerobic zone of treatment with greatly reduced concentrations of alkylbenzenes and oxygen. Laboratory studies done with material from this region confirmed field evidence of anaerobic transformations of the alkylbenzenes. The anaerobic zone of treatment was surrounded by an aerobic zone of treatment with detectable oxygen and even greater reductions in alkylbenzene concentrations. Laboratory studies on material from this zone of treatment confirmed rapid aerobic transformations of the alkylbenzenes. (See also W88-11213) (Author's abstract)
W88-11218

FACILITATED TRANSPORT OF NAPHTHALENE AND PHENANTHRENE IN A SANDY SOIL COLUMN WITH DISSOLVED ORGANIC MATTER - MACROMOLECULES AND MICELLAS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
A. T. Kan, and M. B. Tomson.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 93-106, 6 fig, 1 tab, 17 ref. US EPA Grant CR-812808.

Descriptors: *Groundwater pollution, *Path of pollutants, *Soil contamination, *Organic compounds, *Soil columns, Dissolved solids, Dialysis, Model studies, Biological properties, Cleanup operations, Solute transport, Groundwater movement.

The primary mechanism for the movement of neutral trace level organic compounds, such as toluene and naphthalene, in soil, has been proposed to be chromatographic partitioning of organic compounds between the water phase and the organic carbon fraction of the soil phase. However, hydrophobic compounds are often found orders of magnitude farther than would be expected based on this partitioning theory. Recently, it was proposed that the movement of neutral organic compounds in ground water might be enhanced by sorption onto ground water dissolved organic matter which moves with the velocity of the water. This paper demonstrates this 'facilitated' transport of pollutants in a soil column with dissolved organic compounds. The facilitated transport of naphthalene in ground water by dissolved organic matter was modeled using a fine sand soil column with biological macromolecules and micelles. Molecularly well-defined bovine serum albumin (BSA) and Triton X-100 micelles have been shown to have similar partition properties to natural dissolved organic matter. By dialysis experiments, the partition coefficient of naphthalene with BSA was found to be 10 to the 3.7 power and that with Triton X-100 was found to be 10 to the 3.3 power, versus the organic carbon-based partition coefficient (K sub oc) of 10 to the 3.1 power reported in the literature. Kinetics of sorption to the soil phase was found to be an important factor in contaminant transport. Use of Triton X-100 in aquifer clean-up is feasible and the extent of clean-up may be predictable via the modified retardation equation. (See also W88-11213) (Author's abstract)
W88-11219

DEVELOPMENT AND EXPERIMENTAL VERIFICATION OF A MODEL FOR TRANSPORT OF CONCENTRATED ORGANICS IN THE UNSATURATED ZONE,
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
D. D. Reible, T. H. Illangesekare, D. V. Doshi, and I. F. Ayoub.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 107-127, 7 fig, 2 tab, 23 ref.

Descriptors: *Model studies, *Sand, *Soil columns, *Organic compounds, *Path of pollutants, Petroleum products, Immiscibility, Porous media, Infiltration, Leaching, Soil contamination.

Preliminary experiments were conducted in laboratory sand columns with a variety of water miscible and immiscible organic chemicals with the objective of obtaining a qualitative understanding of the dynamics of the distribution of the different phases. These chemicals included the low solubility chemicals, mineral oil, automatic transmission fluid, carbon tetrachloride, and tetrachloroethylene, and the miscible chemicals, phenol, chloroform, and

methanol. Water was initially at residual saturation during all experiments. Based on these experiments, a simple conceptual model that assumes a piston wetting front (similar to Green-Ampt infiltration front) and drainage front was developed for immiscible fluids. A related model that includes a dissolution zone growing by axial dispersion was developed for miscible chemicals. The empirical parameters of these models were expressed in terms of the physical properties of the porous medium and the organic phase. These models are of a form that is convenient for rapid exposure assessment calculations. (See also W88-11213) (Author's abstract)
W88-11220

RAPID ASSESSMENT MODEL FOR SPILLS ON SOIL OF OILY FLUIDS THAT ARE IMMISCIBLE WITH WATER,
Canviro Consultants Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 5A.
W88-11221

KINETIC INTERACTION OF NEUTRAL TRACE LEVEL ORGANIC COMPOUNDS WITH SOIL ORGANIC MATERIAL,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
G. L. Clark, A. T. Kan, and M. B. Tomson.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 151-156, 3 fig, 1 tab, 7 ref.

Descriptors: *Organic compounds, *Chemical reactions, *Soil organic matter, *Mathematical models, *Mathematical models, *Path of pollutants, *Kinetics, Sorption, Infiltration, Equilibrium, Local equilibrium assumption.

Sorption of trace level organic compounds can be viewed as an equilibrium or kinetic process. By making the local equilibrium assumption (LEA), i.e., that the organic compound has sufficient time to come into complete equilibrium with the soil organic matter, the mathematical model is considerably simplified. This simplification has resulted in the use of LEA for many contaminant transport models. Recent work has shown that LEA is not valid for all systems and that kinetics should not be considered. This paper involves investigation of the rate at which LEA is valid and determination of the effect of kinetics upon the sorption of contaminants onto soil in a flowing column system. Analysis showed that, for tested compounds such as toluene, naphthalene and ethyl benzene, as flow rates increase, the slower sorption process is too slow relative to the fluid flow for sorption equilibrium and only the rapid sorption process is observed. (See also W88-11213) (Author's abstract)
W88-11222

DATA ANALYSES AND COMPUTER MODELING OF THE BENZENE PLUME IN AN AQUIFER BENEATH A GAS PLANT,
C. Y. Chiang, C. L. Klein, J. P. Salanitro, and H. L. Wisniewski.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 157-176, 9 fig, 13 ref.

Descriptors: *Data interpretation, *Computer models, *Benzenes, *Groundwater pollution, *Path of Pollutants, Aquifer management, Organic compounds, Petroleum products, Hydrocarbons, Sampling, Mathematical equations, Biodegradation, Plumes, Model studies, Michigan.

A flare pit has become a potential source of hydrocarbon pollution for the aquifer beneath a gas plant in Michigan. Hydrocarbon presence in the shallow aquifer beneath the site was characterized by sampling soil and water quality at 38 monitoring wells/soil borings and 7 boreholes. Results from 9 sampling periods over 15 months for benzene concentrations show significant disappearance in total benzene mass with time in the ground water. A material balance is presented based on field data to investigate the mechanism or mechanisms that caused the benzene mass reduction. In addition, the degradation of benzene, toluene, and xylene (BTX) by soil microbes was determined in subsurface core material using laboratory test tube microcosms. Results from the material balance analysis of field data and microcosm experiments in Shell Oil's laboratory suggest that microbial degradation may be the major mechanism that caused the apparent decrease in total benzene mass. The first order degradation rate constants and the leakage rates from the flare pit and the slop oil tank were calculated by Newton's method for multivariable problems and by nonlinear least squares for an overdetermined system of equations. The degradation rate constants determined from the material balance analysis were within an order of magnitude of the rates obtained from microcosm experiments, which suggests that the field-determined rates may be realistic. The direction of the soluble benzene plume as well as the source or sources of hydrocarbons have been characterized through benzene concentration isopleths plots. The USGS-MOC Solute Transport numerical model has been used to further delineate the source strengths and to characterize the soluble plume migration. (See also W88-11213) (Author's abstract)
W88-11223

VADOSE ZONE LITHOLOGICAL INFLUENCES ON LIQUID HYDROCARBON TRANSPORT AND PLUME DELINEATION,
Delaware State Dept. of Natural Resources and Environmental Control, Dover.
M. F. Boller.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 179-188, 6 fig.

Descriptors: *Geohydrology, *Soil water, *Vadose water, *Plumes, *Path of pollutants, *Hydrocarbons, Groundwater pollution, Geology, Soil moisture, Groundwater flow, Vertical flow, Lithology, Case studies, Permeability, Porosity.

Liquid phase hydrocarbon transport in the Coastal Plain and Piedmont physiographic provinces in Delaware depends on many factors, including the volume and viscosity of the spent hydrocarbon, soil moisture content, depth to ground water, nature of the aquifer, local topography, location and backfill of underground utility lines, and vadose zone lithology. Too often evaluation of hydrocarbon transport involves only consideration of saturated sediment lithology, ground water flow direction, free product thicknesses, and ground water quality. Frequently the lithology of the vadose zone through which the released hydrocarbon must first move is not always vertical as is usually assumed. Without analyzing the properties of hydrocarbon migration in the vadose zone, determining the dimensions of free and dissolved hydrocarbon plumes may be inaccurate or at least more complex and costly than need be. Two case histories are presented to show how analyzing the vadose zone lithology was necessary to explain unusual contaminant plume shapes and the accumulation of substantial amounts of free and dissolved hydrocarbons in upgradient monitor wells. The studies illustrate that layers of relatively low permeability, especially clay or silt lenses, and effective porosity are important factors in preventing transport of a liquid. Slow leaks may never saturate the vadose zone where the depth of ground water is great. The hydrocarbons become trapped, adsorbed or volatized. (See also W88-11213) (Author's abstract)
W88-11224

MODELING MULTIPHASE CONTAMINANT TRANSPORT IN GROUND WATER AND VADOSE ZONES,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. C. Parker, R. J. Lenhard, and T. Kuppusamy.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 189-203, 7 fig, 1 tab, 15 ref. Battelle Pacific Northwest Laboratories subcontract B-N3935-A-E, U.S. EPA Assistance Agreement CR-812073-02.

Descriptors: *Hydrologic models, *Model studies, *Soil water, *Path of pollutants, *Groundwater pollution, *Plumes, *Vadose water, Immiscibility, Permeability, Organic compounds, Hydrocarbons, Aeration zone, Saturation zone, Chemical properties, Trichloroethylene, Soil contamination.

A mathematical model is presented for the movement of water-immiscible organic fluids in the variably air-saturated vadose zone and in groundwater. Constitutive relationships for fluid permeabilities and saturations versus fluid pressures are derived on the assumption that wettabilities follow the sequence water > hydrocarbon > air. For monotonic saturation path, water saturation (S sub w) is assumed to be a unique function of the pressure difference between water and hydrocarbon phases (P sub ow); total liquid saturation (S sub t) is similarly assumed to be a function of the pressure difference between air and hydrocarbon phases (P sub ao). Linear transformations of S sub w (P sub ow) and S sub t (P sub ao) by fluid-dependent scaling factors are applied to obtain a single scaled saturation pressure function that can be accurately described by means of a simple but general parametric form. The scaled saturation-pressure function is used in conjunction with a pore structure model to derive simple closed-form expressions for fluid relative permeabilities as functions of the fluid pressures. The multiphase flow model is solved by a variational finite element method using linear shape functions, backwards finite difference time integration method, and a modified Picard iteration scheme for one- or two-dimensional spatial domains. A comparison of transient water displacement from soil cores by trichloroethylene (TCE) at constant pressure with numerical simulations based on independent measurements of model parameters indicated that the assumed formulation provides a satisfactory description of the multiphase flow properties of TCE in this porous medium. (See also W88-11213) (Author's abstract)
W88-11225

SIMULATION OF THE MOVEMENT OF VOLATILE ORGANIC VAPOR THROUGH THE UNSATURATED ZONE AS IT PERTAINS TO SOIL-GAS SURVEYS,
Hydrosystems, Inc., Falls Church, VA.
L. R. Silka.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 204-224, 4 fig, 4 tab, 22 ref.

Descriptors: *Model studies, *Simulation, *Aeration zone, *Soil water, *Soil gases, *Path of pollutants, Volatility, Sensitivity analysis, Infiltration, Organic compounds, Soil columns, Computer studies, Sampling, Diffusion, Optimization.

A description is given of the finite-difference vapor diffusion model and the results of sensitivity analyses of vapor diffusion through soil gas. Sensitivity analyses demonstrate the importance of soil moisture and organic matter content in controlling the migration of volatile organic compound (VOC) vapor through the unsaturated zone. The first phase of the research involved the development of a computer model to simulate the movement of VOCs through unsaturated soils to evaluate the factors affecting the transport of VOC vapor in the unsaturated zone. The next phase involved controlled column experiments to develop data on the rates of VOC diffusion through unsaturated soils. Results of soil-gas surveys indicated that the vapor diffusion model provides reasonable predictions of VOC vapor concentration surrounding a surface zone. The model was used successfully to optimize

the sampling grid for these surveys. (See also W88-11213) (Author's abstract)
W88-11226

MTBE AS A GROUND WATER CONTAMINANT,
Maine Dept. of Environmental Protection, Augusta.
P. Garrett, and M. Moreau.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 227-238, 4 fig, 2 tab, 7 ref.

Descriptors: *Path of pollutants, *Methyl tertiary butyl ether, *Water pollution treatment, *Groundwater pollution, *Gasoline, *Cleanup operations, Population exposure, Activated carbon, Infiltration, Air stripping, Petroleum products.

When MTBE (Methyl tertiary Butyl Ether), used exclusively an octane enhancer in gasoline, leaks to ground water, it spreads both further and faster than the gasoline, and the concentration of gasoline dissolved in ground water increases. This paper describes several cases of ground water contamination resulting from spills of gasoline with MTBE. In one such case, several household wells became contaminated with MTBE only. In one household, concentrations of up to 690 ppb MTBE were measured (with other gasoline constituents combined at less than 10 ppb). The well nearest the spill had concentrations of up to 126,000 ppb gasoline including MTBE. At another site, concentrations exceeded 600,000 ppb gasoline including MTBE. This contrasts with the usual maximum dissolved concentration of gasoline in ground water near spill sites of about 10-30,000 ppb (when no MTBE is present). Ground water contaminated with MTBE is difficult to remediate. Filtration through activated carbon is not cost effective for MTBE: a 2 cubic foot bed lasts a month or less as a household treatment system, even with an influent concentration of MTBE as low as a few parts per billion. However, air stripping systems are capable of removing MTBE, but only if very high air to water ratios are used. These investigations showed that the presence of MTBE in spilled gasoline increases dissolved concentrations of gasoline in ground water in the immediate vicinity of the spill to about an order of magnitude above typical values for spill in which there is no MTBE, and MTBE is more difficult to remove from contaminated water than the other components of gasoline. (See also W88-11213) (Author's abstract)
W88-11227

HYDROLYSIS OF 1,1,1-TRICHLOROETHANE; FORMATION OF 1,1-DICHLOROETHENE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. V. Cline, J. J. Delfino, and W. J. Cooper.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 239-248, 1 fig, 3 tab, 14 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Trichloroethane, *Dichloroethenes, *Chemical degradation, *Chemical reactions, Molecular structure, Chemical properties, Pollutants, Hydrogen ion concentration, Chlorinated ethenes, Groundwater pollution, Chlorinated hydrocarbons, Temperature.

Two distinct pathways occur in the degradation of 1,1,1-trichloroethane (TCA). Substitution leads to the formation of acetic acid, and elimination that produces 1,1,-dichloroehene (1,1-DCE). This paper demonstrates the formation of 1,1-DCE from hydrolysis of TCA in a ground water medium under laboratory conditions. The rate of degradation of TCA depends on temperature, and is relatively independent of pH between 4 and 9. The rate at 55 C was found to be 0.136/day, and at 35 C, 37% of TCA was degraded after 1 month. Approximately 30% of the TCA degraded produced 1,1-DCE, while other degradation products remain unidentified but are assumed to be acetic acid that has been identified as the hydrolysis product. Chlorinated ethenes are generally considered to be resistant to degradation. 1,1-DCE shows 25% degradation after 30 days at 35 C. This is a faster rate than observed at 27 C or 80 C. The proposed initial step in the reaction is nucleophilic addition to the double bond, which is less favorable at elevated temperatures. This points to the need for caution in performing some of these reactions at elevated temperatures to predict behavior at environmental temperatures. (See also W88-11213) (Author's abstract)
W88-11228

IRON DISSOLUTION RESULTING FROM PETROLEUM-PRODUCT CONTAMINATION IN SOIL AND GROUND WATER. 1. THERMODYNAMIC CONSIDERATIONS,
Weston (Roy F.), Inc., Albuquerque, NM.
P. Longmire.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 249-269, 3 fig, 2 tab, 42 ref.

Descriptors: *Path of pollutants, *Soil contamination, *Groundwater pollution, *Petroleum products, *Iron, *Leachates, Thermodynamics, Heavy metals, Plumes, Oxidation, Solubility, Anaerobic conditions, New Mexico, Oxidation-reduction potential, Hydrogen ion concentration.

Contamination of soil and ground water by petroleum products enhances the generation of an anaerobic leachate that has a significant impact on ground water quality. Anomalously high concentrations of dissolved iron as well as a depletion of dissolved oxygen can occur where the dissolution of iron phases such as ferric hydroxide has taken place within an advancing petroleum-product plume. This paper deals with the thermodynamics of coupled oxidation and reduction reactions of ferric hydroxide and relevant solute species with application to petroleum-product contamination. The effects on ferric hydroxide solubility in anaerobic ground water are described through the use of Eh-pH diagrams and other solubility graphs. The samples for this investigation were obtained at several field sites in Albuquerque, Ruidoso, and Taos, NM. Ground water samples were collected from the Santa Fe Group and alluvial aquifers. Temperature, conductivity, pH, and Eh were measured in the field. Results showed that uncomplexed and complexed iron species are mobile in chemically reducing ground water. Ferrous iron may form complexes with catechol, a microbial oxidation product of benzene, toluene, and napthalene, and other organic ligands within the dissolved petroleum product plume. Dissolution of ferric hydroxide and other iron oxyhydroxides may result in the release of several trace elements including manganese and arsenic. Elevated concentration of these trace elements may persist until chemically oxidizing conditions are established and the solid iron phase reprecipitates from solution. (See also W88-11213) (Author's abstract)
W88-11229

MONITORING A HYDROCARBON LAND TREATMENT FACILITY IN CLAYEY GLACIAL TILL,
Tellus Consultants, Inc., Minneapolis, MN.
For primary bibliographic entry see Field 7A.
W88-11233

ROLE OF GEOLOGIC CHARACTERIZATION IN DETERMINING MIGRATION OF HYDROCARBON SPILLS: A CASE STUDY,
EMCON Associates, San Jose, CA.
For primary bibliographic entry see Field 5G.
W88-11234

FOUR-DIMENSIONAL PERSPECTIVE OF AN UNDERGROUND FUEL OIL TANK LEAKAGE,
Unity Coll., ME.
W. B. Kerfoot, and W. Sanford.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 382-403, 9 fig, 3 tab, 10 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Oil, *Groundwater pollution, *Plumes, *Leakage, Fracture permeability, Groundwater flow, Cleanup operations, Water quality control, Petroleum products, Underground storage, Soil gases, Gas chromatography, Groundwater movement.

The characteristics are described of release of No. 2 fuel oil from a corroded small-volume (500 gallons) subsurface tank and the movement of hydrocarbon fractions from the release location into ground water and downgradient for about 1000 feet. The local flow network was analyzed over time to complete an analysis of the contaminant pathway and source. Without the historical pathway analysis, the original configuration of contamination would have defied rational analysis. The results of the investigation led to the following conclusions: (1) time-varying local flow conditions can create great difficulties in source identification; (2) the combination of soil vapor profiling and portable gas chromatography fingerprinting can provide valuable assistance to gradient and flow analysis during source identification in complex flow environments; (3) an historical contaminant pathway analysis can be a useful tool in understanding plume configurations; (4) small-volume underground fuel oil storage tank leakage can release sufficient dissolved aromatic fractions (benzene and toluene) to constitute a hazard to shallow, small-volume private well sources in sand and gravel aquifers; (5) removal of the contaminant source and exposure of the contaminated soil resulted in a rapid recovery of ground water conditions; and (6) a gas monitoring system capable of being installed without removal of the tank or disruption of supply should be considered for early leak detection for buried storage tanks. (See also W88-11213) (Author's abstract)
W88-11236

DIFFUSION OF GASOLINE-RANGE HYDROCARBON VAPORS IN POROUS MEDIA, EXPERIMENTAL METHODOLOGIES,
Lowell Univ., MA. Coll. of Engineering.
C. J. Bruell, and G. E. Hoag.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 420-443, 10 fig, 7 tab, 21 ref.

Descriptors: *Diffusion, *Path of pollutants, *Chemical properties, *Hydrocarbons, *Physical properties, Soil columns, Immiscibility, Vapor diffusion, Oil spills, Simulation, Gasoline, Benzenes, Soil porosity, Discharge measurements.

A variety of physical and chemical factors affecting the diffusion of gasoline-range hydrocarbon vapors were investigated using prototype soil column test reactors. Experimentation was designed to simulate actual stabilized boundary conditions following a spill or subsurface discharge of immiscible contaminants (e.g., gasoline hydrocarbons) to the unsaturated zone. Experimental results are compared with values predicted using existing theory that describes gaseous diffusive flux through soil columns. Soil column reactors were constructed of 4 in. I.D. aluminum pipe, and consisted of a liquid hydrocarbon reservoir, soil support screen, 15 in. soil column with sample ports, an enclosed headspace and a metered headspace sweep gas device. The design of the column allowed the measurement of hydrocarbon concentration gradients and hydrocarbon flux rates. The diffusion of benzene vapor was observed in a series of experiments design to isolate and evaluated the physical effects of soil factors such as temperature, effective porosity, tortuosity and moisture content. The individual diffusion of hexane, isooctane, ben-

zene and toluene vapor was observed to determine the effect of solvent type. Results indicate that vapor diffusion is a significant factor in the movement of gasoline-range hydrocarbons within ground water systems. A simplified vapor diffusion model for gasoline-range hydrocarbons in the unsaturated zone is presented and demonstrated. (See also W88-11213) (Author's abstract)
W88-11238

FIELD AND INTERPRETATION TECHNIQUES FOR DELINEATING SUBSURFACE PETROLEUM HYDROCARBON SPILLS USING SOIL GAS ANALYSIS,
Tracer Research Corp., Tucson, AZ.
For primary bibliographic entry see Field 5A.
W88-11239

SIMULATION OF LEACHATE GENERATION FROM MUNICIPAL SOLID WASTE,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
N. D. Williams, F. G. Pohland, K. C. McGowan, and F. M. Saunders.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-227005. Price codes: A06 in paper copy, A01 in microfiche. EPA Report No. EPA/600/2-87/059, August 1987. 168 p, 73 fig, 3 tab, 72 ref, 2 append. EPA Contract CR812580010. Georgia Tech Project E20-684.

Descriptors: *Simulation analysis, *Leachates, *Municipal wastes, *Solid waste disposal, *Water pollution sources, *Waste disposal, Model studies, Percolation, Mathematical models, Stabilization, Landfills, Fermentation, Acidification, Hydrolysis, Biodegradation.

The simulation of leachate generation from a municipal solid waste landfill or landfill simulation should utilize a mechanistic model which properly accounts for the microbially mediated processes of landfill stabilization. Several leachate generation models have been developed based on the solubility of the waste constituents in water percolating through a landfill. These models, called 'washout models' provided a reasonable approximation of leachate constituent concentrations after the landfill or landfill simulation reached a period of relative dormancy, called maturation, but were deficient in predicting leachate constituent concentrations in the early stages of the landfill. These early stages in the life of a landfill are extremely important because, in most cases, the highest leachate concentrations and the most extreme conditions a liner or the surrounding environment would be subjected to occur very early in the life of the landfill. A mechanistic three step model, GTLEACH-I, was developed to simulate the microbially mediated processes of landfill stabilization in terms of hydrolysis of substrate, acid formation and methane fermentation. The model was applied to two sets of experimental data and provided a reasonable prediction of volatile acids and gas generation. (Author's abstract)
W88-11263

PRODUCTION WATERS ASSOCIATED WITH THE PRODUCTION, PROCESSING, TRANSMISSION, AND STORAGE OF NATURAL GAS: A LITERATURE SURVEY,
ERT, Pittsburgh, PA.
For primary bibliographic entry see Field 5D.
W88-11268

ENVIRONMENTAL EFFECTS OF RADIATION EMERGENCIES,
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
For primary bibliographic entry see Field 4C.
W88-11281

ASSESSMENT OF PHOSPHORUS IN CONODOGUINET CREEK, CUMBERLAND COUNTY, PENNSYLVANIA,
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran, and R. J. Schott.
Susquehanna River Basin Commission, Harrisburg, PA. Publication No. 114, June 1988. 44 p, 9 fig, 11 tab, 2 ref.

Descriptors: *Water availability, *Conodoguinet Creek, *Pennsylvania, *Path of pollutants, *Streams, *Phosphorus, Dissolved oxygen, Aquatic plants, Respiration, Eutrophication, Biomass, Wastewater treatment facilities.

Conodoguinet Creek is nutrient enriched throughout its lower 16 miles. Low dissolved oxygen concentrations, some near or below the minimum standard of 4.0 mg/L, occur in several reaches due to aquatic plant respiration. A study was conducted to assess phosphorus assimilation for reaches downstream of sewage treatment plant discharges. Methodology developed by the Pennsylvania Department of Environmental Resources was used to produce phosphorus extraction coefficients which could be used by water quality managers to calculate effluent limits on discharges. The resulting extraction coefficients indicated eutrophic conditions, but were not suitable for use in calculating effluent limits because they were an order of magnitude greater than suggested in the implementation guidance. Using such high values could result in excessively high effluent limits which would not improve stream water quality. Reduction of plant biomass will improve water quality in Conodoguinet Creek and may be attained through the reduction of phosphorus concentrations. All of the sewage treatment plants discharging to the lower reaches of Conodoguinet Creek contribute phosphorus loads large enough to be subject to stricter controls. Elimination of impounded reaches will also enhance water quality. Additional impounding of the lower 16 miles of Conodoguinet Creek should be prohibited. (Author's abstract)
W88-11286

5C. Effects Of Pollution

EFFECTS OF FLY ASH AND FLUE-GAS DESULFURIZATION WASTES ON GROUNDWATER QUALITY IN A RECLAIMED LIGNITE STRIP MINE DISPOSAL SITE,
North Dakota Univ., Grand Forks. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-10099

MEIOBENTHOS OF A LAKE CHAIN AFFECTED BY PULP MILL EFFLUENT,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
J. Sarkka.
Aqua Fennica AQFEDI, Vol. 17, No. 1, p 35-41, 1987. 1 fig, 4 tab, 21 ref.

Descriptors: *Lakes, *Pulp wastes, *Aquatic animals, *Oligochaetes, *Water pollution effects, *Crustaceans, *Benthic fauna, Population exposure, Biomass, Eutrophication, Pulp and paper industry, Kraft mills, Rotifers.

This paper presents species-level abundance of microcrustaceans and oligochaetes and their vertical distribution in sediments. On an area comprising stations near the pulp mill in Aanekoski and cleaner reference sites, the diversity of the meiobenthos was lowest near the source of organic pollution. Rotifers were dominant in the most polluted lake, where there is pronounced sedimentation of organic matter. Nematodes dominated the biomass particularly in the most polluted area and were more abundant in the semilotic than in the purely lacustrine environments. Of meiobenthic oligochaetes, Chaetogaster langi was found on the area from the most polluted area to the eutrophic northern part of Lake Paijanne. Canthocamptus staphylinus was the only harpacticoid species living in the most polluted environment, while Attheyella crassa, Moraria brevipes, Bryocamptus echinatus and Paracamputus schmeili were restricted to cleaner waters. Of the cladocerans species of Iliocryptus did not show any marked relation to pollution, but Leydigia quandrangularis was found only in cleaner areas. A considerable proportion of the animals in the most polluted semilotic environment were living in the deeper layers of the sediment. (Author's abstract)
W88-10113

UTILITY OF THE MORPHOEDAPHIC INDEX IN THE PREDICTION OF FISH YIELD IN FINNISH LAKES,
Turku Univ. (Finland). Dept. of Biology.
M. Rajasilta, and J. Salo.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 157-163, 1987. 3 fig, 2 tab, 23 ref.

Descriptors: *Fisheries, *Lake Morphology, *Finland, *Fish populations, *Water pollution effects, *Fish harvest, Mathematical studies, Prediction, Data aquisition, Estimating.

In lake management the prediction of fish yield and production are of primary importance. In addition to planning the fisheries in lakes, values of fish yield are needed when the effects of pollution to fish stocks and fishery are estimated. Collecting the data is laborious, however, and for this reason different indirect methods have been developed in hydrobiology to estimate the fish yield or production. One of the most well-known estimators is the morphoedaphic index (MEI) presented by Ryder (1965), which is based on the morphometric and edaphic properties of the lake. In this paper, the authors have calculated the relation between the fish yield (kg/ha/a) and the MEI in Finnish lakes (N=20). The MEI was expressed as a ratio-conductivity:mean depth or total fixed residue:mean depth. In the former case, the fish yield was $y = 0.51x + 5.16$ (r squared = 0.785; $P < 0.001$) and in the latter $y = 1.24x + 3.68$ (r squared = 0.741; $P < 0.001$). Mean depth alone had no correlation with the yield (r squared = 0.03; NS). Fishing effort correlated positively with the fish yield (r squared = 0.248; $P < 0.05$). According to stepwise multiple regression analysis, the MEI calculated as the ratio conductivity:mean depth explained alone 83.8% of the yield variability ($P < 0.001$; df=13). (Author's abstract)
W88-10121

RELATIONS BETWEEN PLANKTIC BLUE-GREEN ALGAL DYNAMICS AND ENVIRONMENTAL FACTORS IN FOUR EUTROPHIC SWEDISH LAKES,
Moi Univ., Eldoret (Kenya). Dept. of Wildlife Management.
For primary bibliographic entry see Field 2H.
W88-10127

MICROBIAL INVESTIGATIONS IN RIVERS: VII. SEASONAL VARIATIONS OF BACTERIAL NUMBERS AND ACTIVITY IN EUTROPHIED RIVERS OF NORTHERN GERMANY,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
K. Gocke, and G. Rheinheimer.
Archiv fuer Hydrobiologie AHYBA4, Vol. 112, No. 2, p 197-219, April 1988. 9 fig, 4 tab, 34 ref.

Descriptors: *Eutrophication, *Stream biota, *Biomass, *Bacteria, *Saprophytic bacteria, Water chemistry, Coliforms, Population dynamics, Aquatic populations, Water chemistry, Heterotrophic bacteria, Ecosystems, Seasonal variation, Germany.

Over a period of 2 years, water samples were taken at monthly intervals from a midstream station of the Elbe and the Trave Rivers (Northern Germany). Besides physical and chemical parameters, the following variables were investigated: total bacterial numbers and biomass by means of direct microscopical counts, numbers of saprophytes, numbers of coliform bacteria and the turnover times (T sub 1) and turnover rates (T sub r) of glucose, aspartic acid and acetate as a measure of the heterotrophic activity. The average annual values found for the Elbe and Trave Rivers, respectively, were: total numbers of bacteria 0.00000114 and 0.00000105 cells/ml; bacterial biomass 154 and 129 micrograms/Cl; saprophytes 0.00825 and 0.00489 cells/ml; turnover time for glucose 1.89 and 3.18 h; T sub t for aspartic acid 1.20 and 2.10 h; T sub t for

acetate 1.12 and 1.94 h. The heterotrophic activity (T sub r) shows a clear annual periodicity with high values in the summer and lower ones in the winter. The differences between the most extreme values, which for both rivers are less than one order of magnitude, are more pronounced in the Trave. This is due to the fact that, in this river, total bacterial numbers are highly significantly correlated with the temperature, so that the influence of number and temperature on the turnover rates works in the same direction. In the Elbe, on the other hand, no significant correlation between temperature and total bacterial numbers was observed. Thus, in this river the increase in heterotrophic activity during the summer is relatively small and almost completely explainable by the rise of the temperature alone. (Author's abstract)
W88-10129

SUBLITTORAL EROSION OF UNTERSEE (LAKE CONSTANCE). LATE CONSEQUENCES OF EUTROPHICATION AND HYDROLOGICAL PHENOMENA,
Konstanz Univ. (Germany, F.R.). Inst. fuer Seenforschung und Fischereiwesen.
V. R. Schroder.
Archiv fuer Hydrobiologie AHYBA4, Vol. 112, No. 2, p 265-277, April 1988. 5 fig, 14 ref.

Descriptors: *Water pollution effects, *Littoral environment, *Lake sediments, *Lake shores, *Sediment erosion, *Eutrophication, Lakes, Aquatic plants, Ecosystems.

The littoral of Lake Constance consists of a sublittoral section up to 1 km wide, comparable to the ocean shelf. For some years a transportation of sediments to greater depths has been observed. This even must have happened for the first time in the history of the lake as objects of the neolithic periods (poles, fragments of pots and weapons) appeared at the sediment surface. The sublittoral zone of the lake was covered with a dense submersed vegetation, consisting of Chara meadows in the shallow areas and of Potamogeton perfoliatus, P. lucens and Myriophyllum spicatum. These species produced a considerable wave damping effect on the shoreline and must have evoked the process of sedimentation and accumulation. As a consequence of the strong eutrophication of the lake the Chara-meadows and the Potamogeton and Myriophyllum stand disappeared completely. A new grass-like vegetation developed, consisting mainly of Zannichellia palustris, Potamogeton pectinatus and P. pusillus. These species could not withstand the wave action as the former vegetation was able to and brought its vegetation period to a close as early as September. Afterwards, the sublittoral was freed of vegetation when the water depth was low and autumn storms were frequent. The horizontal sediment transport was established over a spring period of three weeks. In the most shallow area (0-1 m depth), the daily transport amounts to 1.4 kg/sq m, in 1-2 m depth 0.35 kg/sq m, and in the depth of 2-5 m it is around 0.10 kg/sq m. This means that the introduced energy mainly derives from breakers. Since about 1980, the concentration of dissolved phosphorus is decreasing. Around 1982 the Chara-meadows expanded over the sublittoral zones and considerable stands of Potamogeton perfoliatus and Myriophyllum appeared all over the lake. It is to be expected that the erosion of the 'shelf' will not continue and a period of sedimentation will set in. (Author's abstract)
W88-10132

EXPERIMENTAL STUDIES OF THE EFFECTS OF ZINC ON ANCYLUS FLUVIATILIS (MUELLER) (MOLLUSCA; GASTROPODA) FROM THE AFON CRAFNANT, N. WALES,
Liverpool Univ. (England). Dept. of Zoology.
M. Willis.
Archiv fuer Hydrobiologie AHYBA4, Vol. 112, No. 2, p 299-316, April 1988. 5 fig, 8 tab, 23 ref.

Descriptors: *Zinc, *Heavy metals, *Water pollution effects, *Mollusks, *Toxicity, Population exposure, Sublethal limit, Population dynamics, Aquatic animals, Aquatic environments, Fertility, Water chemistry, Static water, Wales.

The effects of a range of zinc concentrations on the survival, growth, reproductive success and behavior of Ancylus fluviatilis (Muller) from the Afon Crafnant, N. Wales were studied by use of toxicity tests, breeding populations in artificial stream tanks, static water experiments and a counter current tank. Shell-length used to estimate growth, was measured using a binocular microscope with calibrated eye piece, reproductive success was measured by estimating the number of egg-capsules and the number of eggs per capsule, and behavioral responses by avoidance--preference experiments. Concentrations of 320 micrograms Zn/l were not lethal to adult Ancylus prior to the deposition of egg-capsules. The reproductive capacity was reduced by concentrations as low as 180 micrograms Zn/l. No effect on reproductive capacity was recorded at 100 micrograms Zn/l, but this concentration, in common with higher concentrations, was lethal to newly-hatched spats over one month. No reduction in shell-length was observed with increase in zinc concentration. No short-term behavioral adaptations were observed up to a concentration of 1,000 micrograms Zn/l. These results were related to field results of an earlier survey of Ancylus in the Afon Crafnant, N. Wales. (Author's abstract)
W88-10133

ONCHOCERCIASIS CONTROL PROGRAMME IN WEST AFRICA: TEN YEARS MONITORING OF FISH POPULATIONS,
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 4C.
W88-10141

EFFECTS OF CADMIUM AND LEAD ON GROWTH, RESPIRATION AND ENZYME ACTIVITY OF THE MARINE BACTERIUM PSEUDOMONAS MARINA,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
K. Chan, and A. C. R. Dean.
Chemosphere CMSHAF, Vol. 17, No. 3, p 597-607, 1988. 1 fig, 2 tab, 27 ref.

Descriptors: *Pseudomonas, *Water pollution effects, *Population exposure, *Cadmium, *Lead, *Marine bacteria, Respiration, Growth rates, Enzymes, Heavy metals, Biomass, Heterotrophic bacteria, Metabolism.

Relatively little information is available in the literature concerning the effects of heavy metals on the physiological processes of marine bacteria. Thus, the present study examined the effects of cadmium and lead on growth, respiration, and alkaline phosphatase activities of Pseudomonas marina, one of the most commonly isolated gram-negative, heterotrophic marine bacteria. The effects of cadmium and lead on growth were determined by comparing growth curves obtained from heavy metal-containing and metal-free media. Cadmium and lead both lengthened the lag time between the curves, reduced the growth rate and biomass of P. marina, and the inhibitory effects were proportional to the concentrations of heavy metals ions tested. Oxygen uptake of P. marina was stimulated by the presence of 20 ppm of lead, whereas other concentrations of lead and cadmium at all tested concentrations inhibited O2 uptake of the cultures. Cadmium, at all test concentrations, inhibited alkaline phosphatase activity, whereas a relatively mild inhibitory effect (92% activity remained) on this enzyme was observed with lead at a concentration as high as 100 ppm. The activity of alkaline phosphatase in P. marina was inhibited by short-term exposure to cadmium, and the inhibitory effect was proportional to the cadmium concentration tested. (Friedmann-PTT)
W88-10146

IMPACT OF MANGANESE INTOXICATION ON CERTAIN PARAMETERS OF CARBOHYDRATE METABOLISM OF A FRESHWATER TROPICAL PERCH, COLISA FASCIATUS,
Gorakhpur Univ. (India). Dept. of Zoology.
K. Nath, and N. Kumar.
Chemosphere CMSHAF, Vol. 17, No. 3, p 617-624, 1988. 1 fig, 1 tab, 41 ref.

Descriptors: *Water pollution effects, *Toxicity, *Metabolism, *Fish, *Perch, *Sublethal effects, *Manganese, *Carbohydrates, Heavy metals, Tissue analysis, Population exposure.

This investigation was made to evaluate the toxic effects, following sublethal exposure of manganese, on the muscle glycogen and blood lactate levels of the freshwater tropical perch, C. fasciatus. Fish samples were collected from a local lake; healthy specimens were used only, and were fed on dried shrimp powder 2-3 times daily, withheld 24 h before and during experimentation. Seven aquaria were filled with 15 litres of tap water, containing five fish in each that served as controls. Seven aquaria were filled with 15 litres of water containing sublethal concentrations of 2584 ppm MnSO4-H2O. Fish exposure to the manganese at 3, 6, 12, 24, 48, 72, and 96 hr evoked muscle glycogen depletion at 48, 72, and 96 hr, while blood lactic acid registered significant elevation at 24, 48, 72 and 96 hr. This study clearly shows that the measurement of carbohydrate metabolites may establish a reliable and sensitive method for evaluation of heavy metals and other pollutant toxicity in fish. (Friedmann-PTT)
W88-10147

COMPARISON OF ECOTOXICOLOGICAL DATA BY MEANS OF AN APPROACH COMBINING CLUSTER AND CORRESPONDENCE FACTOR ANALYSIS,
Institut Pasteur de Lyon (France).
For primary bibliographic entry see Field 7C.
W88-10148

ESTABLISHMENT OF A TEST GUIDELINE FOR THE EVALUATION OF FISH TAINTING,
European Chemical Industry Ecology and Toxicology Centre, Brussels (Belgium).
For primary bibliographic entry see Field 7C.
W88-10151

INTERACTIONS BETWEEN COPPER AND SOME CARBAMATE USED IN PHYTOSANITARY TREATMENTS,
Centre des Sciences de l'Environment, Metz (France).
P. Vasseur, D. Dive, Z. Sokar, and H. Bonnemain.
Chemosphere CMSHAF, Vol. 17, No. 4, p 767-782, 1988. 8 fig, 1 tab, 8 ref.

Descriptors: *Interactions, *Carbamate pesticides, *Copper, *Water pollution effects, *Pesticides, *Toxicity, *Chemical properties, Growth rates, Bacteria, Protozoa, Statistical analysis, Synergistic effects, Bioaccumulation, Heavy metals, Zineb, Maneb, Carbaryl, Biolumin escence, Fungicides, Insecticides.

Binary mixtures of copper-pesticide (zineb, maneb, carbaryl) were tested on bacterium, Photobacterium phosphoreum (Microtox test) and the protozoan, Colpidium camylum. Factorial experiments were used, and results treated with multiple regression analysis. The toxic concentrations chosen were between the NOEL (No Effect Level) and the IC sub 50, when considering the inhibition of the bacterial luminescence and the growth rate of protozoa, induced by each toxicant tested alone. Interactions of copper with zineb or maneb resulted in dramatic synergistic effects in the two species: a total inhibition of the bacterial luminescence or of the growth of colpidium cultures occurred at concentrations considered as non-toxic when each compound was tested alone. A synergism could be observed on the luminescent bacteria with concentrations as low as 20 micrograms/liter (ug/l) Cu++ and 9 ug/l zineb or 9 ug/l maneb. On the colpidium cultures, these threshold concentrations were 63 ug/l Cu++, 50 ug/l zineb, 400 ug/l maneb. Carbaryl differed from the two dithiocarbamates since only a slight interaction was registered with copper on the protozoa at high concentrations (0.2 mg/l Cu++, 8 mg/l carbaryl). (Author's abstract)
W88-10152

TOXICOLOGICAL APPROACH FOR DETECTING ORGANIC MICROPOLLUTANTS IN ENVRIONMENTAL SAMPLES,
Istituto di Ricerca sulle Acque, Milan (Italy).
For primary bibliographic entry see Field 5A.
W88-10153

MERITS OF MACROFAUNAL COLONIZATION OF INTERTIDAL MUDFLATS FOR POLLUTION MONITORING: PRELIMINARY STUDY,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5A.
W88-10158

SELENIUM TOXICOSIS IN WILD AQUATIC BIRDS,
Patuxent Wildlife Research Center, Laurel, MD.
H. M. Ohlendorf, A. W. Kilness, J. L. Simmons, R. K. Stroud, and D. J. Hoffmann.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 24, No. 1, p 67-92, May 1988. 9 fig, 3 tab, 51 ref.

Descriptors: *Water pollution effects, *Teratogenesis, *Water birds, *Toxicity, *Path of pollutants, *Selenium, *Drainage water, *Kesterson Reservoir, *California, Ponds, Birds, Tissue analysis, Metabolism, Population exposure, Water pollution, Farm wastes, Food chains.

Severe gross and microscopic lesions and other changes were found in adult aquatic birds and in embryos from Kesterson Reservoir (a portion of Kesterson National Wildlife Refuge), Merced County, California, during 1984. Adult birds from that area were emaciated, had subacute to extensive chronic hepatic lesions, and had excess fluid and fibrin in the peritoneal cavity. Biochemical changes in their livers included elevated glycogen and non-protein-bound sulfhydryl concentrations and glutathione peroxidase activity but lowered protein, total sulfhydryl, and protein-bound sulfhydryl concentrations. Congenital malformations observed grossly in embryos were often multiple and included anophthalmia, microphthalmia, abnormal beaks, amelia, micromelia, ectrodactyly, and hydrocephaly. Mean concentrations of selenium in livers 4.4 ppm, dry weight) and kidneys (96.6 ppm) of birds collected at the Kesterson ponds were about 10 times those found at a nearby control area (8.3 and 12.2 ppm). Apparently, selenium in the agricultural drainage water supplied to the Kesterson ponds has accumulated in the food chain of aquatic birds to toxic concentrations and caused the lesion and other changes observed. (Author's abstract)
W88-10165

ESTIMATION OF QUALITY OF SOME SURFACE WATERS NEAR THE UPPER SILESIA USING THE ALGAL GROWTH TEST,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10174

SPECIES COMPOSITION OF ZOOPLANKTON IN SURFACE WATERS NEAR THE UPPER SILESIA IN THE ASPECT OF WATER QUALITY,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2E.
W88-10175

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS): 14. THE USE OF THE EXPERIMENTAL STREAM METHOD IN EVALUATING THE EFFECT OF AGRICULTURAL POLLUTION,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Kownacki, E. Dumnicka, E. Grabacka, B. Kawecka, and A. Starzecka.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 3, p 381-400, 1985. 10 fig, 1 tab, 12 ref.

Descriptors: *Mountain streams, *Nutrients, *Ecosystems, *Agricultural watersheds, *Eutrophication, *Water pollution effects, Fauna, Bacteria, Algae, Protozoa, Invertebrates, Carbon, Nitrogen, Phosphorus, Experimental streams, Pastoral economy, Poland.

The chemistry, algal and bacterial populations, and micro- and macrofauna of a natural stream and four experimental streams differing in the load of nutrients (C, N, N+P, P) were investigated in the period from October 3 to November 3, 1977. In the experimental streams with increased loads of nutrients, there was an increase in the number of bacteria. This led to an increased number of Ciliata. the greater amounts of nutrients affected the communities of algae and invertebrates to a smaller degree. (Author's abstract)
W88-10176

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 1. RANGE AND AIMS OF THE INVESTIGATION WITH A DESCRIPTION OF THE ENVIRONMENT,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10177

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 2. CHEMICAL COMPOSITION OF THE WATER AND ATMOSPHERIC PRECIPITATION,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Bombowna.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 433-450, 1985. 3 fig, 4 tab, 30 ref.

Descriptors: *Ecology, *Water pollution effects, *Poland, *Air pollution, *Acid rain, *Eutrophication, Lake Chechlo-Naklo, Precipitation, Dusts, Nutrients, Upper Silesian Industrial Region, River Brynica, Rivers, Rivers, Reservoirs, Lakes, Ponds, Water pollution sources, Sulfuric acid, Industrial wastes, Domestic wastes.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. Results show that both the neighborhood of the Silesian metallurgical industry and the agricultural management in the catchment basin of the investigated bodies greatly affect the chemical composition of their waters. In the dam reservoir at Kozlowa Gora and in the Swierklaniec park pond, eutrophication was more advanced than in Lake Chechlo-Naklo. The fertility of these water bodies was caused by the agricultural use of the catchment basin and the inflow of domestic sewage into the River Brynica. The River Brynica is subjected to the emissions of atmospheric pollution, mainly sulfuric oxides. Constant atmospheric pollution due to the neighborhood of the metallurgical industry very frequently results in the development of calcium-sulfate type rainwater which affects both the groundwater and the water found in the reservoirs. (See W88-10177 and W88-10179 thru W88-10188) (Miller-PTT)
W88-10178

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 3. CHEMICAL COMPOSITION OF THE WATER. HEAVY METALS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 451-464, 1985. 1 fig, 6 tab, 52 ref.

Descriptors: *Poland, *Path of pollutants, *Agricultural watersheds, *Industrial watersheds, *Ecology, *Water pollution effects, *Air pollution, *Heavy metals, Chemical composition, Zinc, Lead, Cadmium, Manganese, Upper Silesian Industrial Region, River Brynica, Poland, Rivers, Reservoirs, Lakes, Water pollution, Solute transport.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. In particular, the level of heavy metal concentrations in the surface waters of the upper watershed of the River Brynica is presented. The level of heavy metals in the surface waters at the edge of the Upper Silesian Industrial Region exposed to emissions rich in Zn, Pb, and Cd did not differ much from that in relatively unpolluted waters, although increased concentrations of these metals were observed. Pollution in the River Brynica increased downstream to the dam reservoir, below which, except for Mn, the concentrations of metals decreased. As a result, the balance was negative only for Mn, whereas a considerable portion of the load of the other metals transported into the reservoir with the river water remained in it. The effect of metals on aquatic organisms is discussed. (See W88-10177 thru W88-10178 and W88-10180 thru W88-10188) (Miller-PTT)
W88-10179

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 5. BACTERIOLOGICAL CHARACTERISTICS OF THE WATERS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10181

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 6. COMMUNITIES OF PLANKTON ALGAE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
H. Bucka.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 493-508, 1985. 2 fig, 2 tab, 17 ref.

Descriptors: *Ecology, *Poland, *Water pollution effects, *Agricultural runoff, *Air pollution, *Phytoplankton, Trophic level, Upper Silesian Industrial Region, River Brynica, Rivers, Reservoirs, Lakes, Ponds, Water pollution, Dust, Algae, Catchment basins.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. In particular, the effect of industrial atmospheric pollution and agricultural run-off on the development of communities of plankton algae are investigated. The results showed increased trophy with weak pollution of the first reservoir with the green algae-diatoms character of its phytoplankton being preserved. The lake showed a small number of algae and low fertility and the park pond showed strong eutrophy and the highest pollution level. The River Brynica was purest in its forest section and very polluted and fertile in the lower part and below the dam. (See W88-10177 thru W88-10181 and W88-10183 thru W88-10188) (Miller-PTT)
W88-10182

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 7. ZOOPLANKTON - QUANTITATIVE RELATIONS IN VARIOUS SYSTEMATIC GROUPS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
L. Krzeczkowska-Woloszyn.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p

509-520, 1985. 2 fig, 4 tab, 10 ref.

Descriptors: *Poland, *Air pollution, *Ecology, *Rivers, *Water pollution, *Agricultural runoff, *Agricultural watersheds, *Industrial watersheds, Water quality, Upper Silesian Industrial Region, River Brynica, Reservoirs, Lakes, Ponds, Dust, Trophic level, Bioindicators.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. In particular, the development of zooplankton in the period from 1976 to 1979 in the River Brynica is investigated. These waters are heavily polluted by industrial dusts from the atmosphere and agricultural runoff. Changes in the composition and number of zooplankton resulted mainly from the various trophic levels found. The purity level of these waters was determined on the basis of indicator species to be medium-trophic and highly eutrophic. (See W88-10177 thru W88-10182 and W88-10184 thru W88-10188) (Miller-PTT)
W88-10183

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 8. CILIATA IN BOTTOM SEDIMENTS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
E. Grabacka.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 521-533, 1985. 3 fig, 3 tab, 18 ref.

Descriptors: *Poland, *Agricultural watersheds, *Industrial watersheds, *Ecology, *Reservoirs, *Lakes, *Ponds, *Water pollution effects, *Benthos, *Eutrophication, Catchment basins, Microbenthos, Recreational water bodies, Upper Silesian Industrial Region, River Brynica, Rivers, Water pollution, Bioindicators, Air pollution, Protozoa.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. A qualitative and quantitative investigation of the Ciliata communities in the microbenthos of the bottom sediments is presented. On the basis of the analysis, the examined water bodies were classified as slightly polluted and the park pond, in particular, as strongly eutrophicated. In the biological analysis, water purity was evaluated mainly on the basis of the dominating species. The surface waters of the areas of the catchment basin adjoining the heavily industrialized territories were subject, above all, to atmospheric pollution and showed a weak to medium degree of water pollution. (See W88-10177 thru W88-10183 and W88-10185 thru W88-10188) (Miller-PTT)
W88-10184

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 9. COMMUNITIES OF OLIGOCHAETES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
E. Dumnicka.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 535-545, 1985. 1 fig, 3 tab, 24 ref.

Descriptors: *Ecology, *Agricultural watersheds, *Poland, *Industrial watersheds, *Water pollution effects, *Benthos, *Oligochaetes, Artificial lakes, Heavy metals, Upper Silesian Industrial Region, River Brynica, Rivers, Reservoirs, Lakes, Ponds, Toxicity, Organic loading, Bioindicators, Water pollution.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. The effect of various types of pollution on the oligochaete communities is investigated with particular attention paid to the problem of heavy metal action on these organisms. The composition and structure of oligochaete communities depend on several factors such as the natural character of the run or water body and the kind and level of water pollution. Only in the upper course of the River Brynica is a community typical for lowland rivers present. Communities characteristic for organically polluted waters appear below the reservoir at Kozlowa Gora. In Lake Chechlo-Naklo, a high content of microelements causes elimination of the more sensitive species (especially from the family Naididae). (See W88-10177 thru W88-10184 and W88-10186 thru W88-10188) (Miller-PTT)
W88-10185

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 10. BOTTOM INSECTS WITH SPECIAL REGARD TO CHIRONOMIDAE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. Zieba.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 547-560, 1985. 1 fig, 3 tab, 15 ref.

Descriptors: *Ecology, *Water pollution effects, *Poland, *Agricultural watersheds, *Industrial watersheds, *Benthos, *Heavy metals, *Eutrophication, *Aquatic insects, Midges, Upper Silesian Industrial Region, River Brynica, Rivers, Reservoirs, Lakes, Ponds, Water pollution, Bioindicators, Larvae.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. The quantitative determination of the occurrence of bottom insects in connection with their constant and periodically massive pollution is presented. Apart from a general estimate according to the taxonomic composition, one of the newest indicatory methods based mainly on the occurrence of benthic larvae of insects, was used. The occurrence of Chironomidae was chiefly taken into consideration since they are frequently constant and numerous components of the bottom fauna, even in some polluted waters. Results show that in the River Brynica above the dam reservoir, larvae of the species living in pure or slightly polluted water prevailed among bottom insects. In the dam reservoir at Kozlowa Gora, the number of taxa was distinctly lower than in the forest Lake Chechlo-Naklo or in the Swierklaniec park pond. With the inflow of mixed pollution and considerable ecological differentiation of stations, benthos insects were not found to be distinctly threatened by pollution with heavy metals and run-off from agricultural areas. However, a further inflow of these compounds might markedly reduce the level of occurrence of such insects. (See W88-10177 thru W88-10185 and W88-10187 thru W88-10188) (Miller-PTT)
W88-10186

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 11. ICHTHYOFAUNA OF THE RESERVOIR AT KOZLOWA GORA AND LAKE CHECHLO-NAKLO,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. M. Wlodek, P. Glowacki, and S. Skora.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 561-575, 1985. 1 fig, 2 tab, 14 ref.

Descriptors: *Poland, *Water pollution effects, *Fisheries, *Eutrophication, *Kozlowa Gora River, *Agricultural watersheds, *Industrial watersheds, Potable water, Trophic level, Upper Silesian Industrial Region, Brynica River, Rivers, Lakes, Ponds, Carp, Sport fishing, Reservoirs.

The development of ichthyofauna over more than 25 years in the potable water reservoir at Kozlowa Gora, Poland, is described. Changes in the structure of the ichthyofauna are considered in relation to changes in the trophy of this reservoir. A short description of the ichthyofauna of Lake Chechlo-Naklo is given. The transition from the stage of mesotrophy to that of eutrophy led to a diminution in the number of fish species and of fish codominants. After 1965, only two codominating species were observed. The number of species showing a share of at least 1% of the total weight of ichthyofauna fell from eight to five from 1965 to 1981. The remaining species were of no importance in the control net catches. The reservoir at Kozlowa Gora is constantly used by anglers. The ichthyofauna changed its structure in the mid-sixties under the influence of changes in the environmental factors leading to changes in water trophy in which fish stocking and the activity of anglers also played a role. The fishery character of the reservoir corresponds at present to the third stage of European eutrophic natural lakes. It is a reservoir of the bream-pikeperch type with a satisfactorily stabilized state of fish health. (See W88-10177 thru W88-10186) (Miller-PTT)
W88-10187

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 12. SYNTHETIC OUTLINE OF INVESTIGATION RESULTS AND CONCLUSIONS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. Zieba.
Acta Hydrobiologica AHBPAX, Vol. 27, No. 4, p 577-587, 1985. 1 fig, 1 tab, 14 ref.

Descriptors: *Path of pollutants, *River Brynica, *Agricultural watersheds, *Industrial watersheds, *Ecology, *Water pollution effects, *Poland, *Heavy metals, *Eutrophication, Organic matter, Upper Silesian Industrial Region, Rivers, Reservoirs, Lakes, Ponds, Water pollution, Sediments, Self-purification, Dusts, Air pollution.

The effects of industry and agriculture on three water bodies in the Upper Silesian Industrial Region (the dam reservoir at Kozlowa Gora with the River Brynica, the Swierklaniec park pond and Lake Chechlo-Naklo, Poland) are discussed. In particular, results of the investigation series on the effect of industrial pollution on the waters of the forest-agricultural basin of the River Brynica are recapitulated. An accumulation of heavy metals and an excess of organic matter in bottom sediments of the dam reservoir brought about a deterioration in the quality of this environment. The eutrophicating influence of nutrients prevailed. The occurrence of various plants and animals in the waters indicates their considerable potential for self-purification. In the River Brynica and in the still waters of the basin no noxious effect of the pollution with heavy metals from industrial dusts could be distinctly determined. (See W88-10177 thru W88-10187) (Miller-PTT)
W88-10188

INFLUENCE OF CONTAMINATED PARTICLES ON THE BIOACCUMULATION OF HYDROPHOBIC ORGANIC MICROPOLLUTANTS IN FISH,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
For primary bibliographic entry see Field 5B.
W88-10195

BENTHIC RECOLONIZATION OF A SEDIMENT IN AN EXPERIMENTAL AREA TRANSPLANTED FROM ITS NATURAL SURROUNDINGS (INFRALITTORAL STAGE OF A MEDITERRANEAN BAY, TOULON, FRANCE), (RECOLONISATION BENTHIQUE D'UN SEDIMENT DANS DES ENCEINTES EXPERIMENTALES REPLACEES DANS LE MILIEU NATUREL (ETAGE INFRALITTORAL D'UNE BAIE MEDITERRANEENNE)),

Lille-1 Univ., Wimereux (France). Wimereux Marine Station.
V. Diaz-Castaneda.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 4, p 551-566, 1986. 7 fig, 3 tab, 41 ref (English summary).

Descriptors: *Water pollution effects, *Recolonization, *Benthic fauna, *Marine sediments, *Littoral environment, *Species composition, *Polychaetes, Environmental effects, Multivariate analysis, Benthic environment, Lazarets Bay France, Mediterranean Sea, Sediment transplantation.

The process of recolonization of sediments defaunated by such factors as pollution, anoxia was studied by transplanting samples of this substrate to an area of similar environmental conditions, but less polluted. Azoic sediments, from the etang (pool) de Berre, were placed in experimental boxes of about 5 cu dm fixed at 5 m depth in Lazaret's Bay (Toulon). Two boxes were removed each month during one year; one for the chemical analyses and the other to follow the degree of colonization by macrofauna. Monthly grab samples were also taken in the area surrounding the experimental boxes to compare with the experimental populations. Results concerning lists of species and their abundance were submitted to several multivariate numerical methods: diversity index, calculation of affinity coefficients, factorial analyses of correspondences, and rank-frequency diagrams. Preceding recolonization, a latency phase was observed during which experimental boxes discharged part of their pollutants: their population was then almost absent. The experimental population appeared, diversified and passed through a transitory population dominated by the polychaete Tharyx sp.; finally it evolved towards a structure similar to that of a natural population. The population developed in the experimental boxes after one year is characterized by dominant species different from those of the natural environment: both populations therefore evolved independently 'balancing' themselves according to their own history, arriving however to the same quantitative equilibrium between species. (Author's abstract)
W88-10217

IMPACT OF A DISCHARGE OF SALINE WATER AND ORGANIC POLLUTION ON THE DIATOM POPULATIONS OF THE GANDER (GRAND DUCHY OF LUXEMBOURG) (IMPACT D'UN REJET D'EAU CHARGEE EN SEL ET D'UNE POLLUTION ORGANIQUE SUR LES PEUPLEMENTS DE DIATOMEES DE LA GANDER (GRAND-DUCHE DU LUXEMBOURG)),
Centre de Recherche et d'Education pour la Conservation de la Nature, Verviers (Belgium).
L. Leclercq, and L. Vandevenne.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 2, p 311-317, 1987. 1 fig, 4 tab, 5 ref.

Descriptors: *Water pollution effects, *Saline water, *Aquatic populations, *Diatoms, *Salinity, *Saline-freshwater interfaces, *Oraganic pollutants, Ecology, Luxembourg, Water quality standards.

This study shows the sensitivity of diatoms to small variations of salinity, due to the discharging of salt water into fresh water of a chalk river. However, simultaneous organic pollution complicates the situation. The ecology of 76 taxa found in the Gander, in relation to these two factors (saprobity and salinity) is also presented. Finally, a new organic pollution index and a new diatom are calculated, resulting in an estimation of the level of water quality of the Gander. (Author's abstract)
W88-10248

BIOACCUMULATION OF COPPER AND ZINC BY NEREIS DIVERSICOLOR (ANNELIDA, POLYCHAETA) IN THE BOU REGREG ESTUARY (MOROCCO)(BIOACCUMULATION DU CUIVERE ET DU ZINC CHEZ NEREIS DIVERSICOLOER (ANNELIDE POLYCHETE) DE L'ESTURAIRE DU BOU REGREG (MAROC)),
Laboratoire de Zoologie et d'Ecologie Marine, Angers (France).
For primary bibliographic entry see Field 5B.
W88-10249

SOME CHARACTERISTICS OF MACROBENTHIC FAUNA FROM THE ORGANIC-ENRICHED SEDIMENTS AT TALCAHUANO, CHILE,
Pontificia Univ. Catolica de Chile, Santiago.
C. Oyarzun, F. D. Carrasco, and V. A. Gallardo.
Cahiers de Biologie Marine CBIMA5, Vol. 28, No. 3, p 429-446, 1987. 5 fig, 7 tab, 33 ref.

Descriptors: *Macroinvertebrates, *Enrichment, *Water pollution sources, *Coastal waters, *Benthic fauna, *Aquatic animals, Aquatic populations, Organic matter, Chile, Marine sediments.

The analysis of sediments from the soft bottom of Talcahuano Port, Concepcion Bay, Chile, showed that the station nearest to Talcahuano fishery port (station C1) had the highest amount of volatile organic matter, and this fraction decreased toward the more distant station (C3). This high enrichment was probably due to the input into the subtidal sediments of organic material coming from port facility activities (fishery factories, merchant ships) and municipal sewage discharges. The enriched station C1 presented significantly higher values of density and biomass when tested against corresponding values from station C2 and C3. Station C1 exhibited a significantly lower number of species. This increase in density and biomass accompanied by a reduction in the number of species, has been recorded in previous studies, where organically enriched benthic localities showed similar characteristics with the enhancement due to opportunistic species, generally regarded as pollution indicators, or in regions where a gradient of organic matter enrichment has been studied. (Friedmann-PTT)
W88-10250

EFFECTS OF NITRILOACETIC ACID, CD AND HG ON THE MARINE ALGAE DUNALIELLA TERTIOLECTA AND ISOCHRYSIS GALBANA,
Padua Univ. (Italy). Dept. of Biology.
M. Bressan, and R. Brunetti.
Water Research WATRAG, Vol. 22, No. 5, p 553-556, May 1988. 6 fig, 30 ref.

Descriptors: *Water pollution effects, *Toxicity, *Nitrilotriacetic acid, *Cadmium, *Mercury, *Algae, Dunaliella, Phytotoxicity, Chlorophyta, Isochrysis, Cultures, Population dynamics, Heavy metals, Chelation.

Microalgae Dunaliella tertiolecta and Isochrysis galbana were cultured in the presence of either nitrilotriacetic acid (NTA), the heavy metals Cd and Hg, or the metals and NTA. NTA was present at levels of 1, 5, or 10 mg/L. Cadmium levels were 13.8 mg/L for D. tertiolecta and 0.2 mg/L for I. galbana, while Hg levels were 0.96 mg/L and 0.02 mg/L respectively. When both metals and NTA were present, the metal levels were the same, and NTA was added in 1:1, 1:2, 1:3 molar ratios. Population growth data show the absence of toxicity of NTA and the absence of interaction of NTA with the toxic effects of Cd and Hg. NTA's possible environmental impact arises from its capacity to chelate metal ions whether they are toxic or not, not from NTA's toxicity per se. (VerNooy-PTT)
W88-10262

DIVERSITY AND COMMUNITY COMPARISON INDICES: ASSESSING MACROINVERTEBRATE RECOVERY FOLLOWING A GASOLINE SPILL,
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
K. W. Pontasch, and M. A. Brusven.
Water Research WATRAG, Vol. 22, No. 5, p 619-626, May 1988. 10 fig, 2 tab, 34 ref.

Descriptors: *Water pollution effects, *Species diversity, *Population density, *Macroinvertebrates, *Oil spills, *Gasoline, Quantitative analysis, Community comparison, Stream pollution, Population exposure, Aquatic populations, Water pollution effects, Comparison studies, Population dynamics, Mathematical models, Wolf Lodge Creek, Idaho, Recolonization.

Diversity and community comparison indices were evaluated to determine their utility in quantifying macroinvertebrate response to a catastropic gasoline spill into Wolf Lodge Creek, Idaho. The Shannon and Brillouin diversity indices, and the following community comparison indices were analyzed: (1) Jaccard's coefficient of similarity; (2) Renkonen's percentage similarity; (3) Bray-Curtis index; (4) Morisita's similarity index; (5) simplified Morisita index; (6) Canberra metric index; and (7) average chi square index. The Bray-Curtis and average Chi square community comparison indices were more effective in quantifying differences in macroinvertebrate composition between gas-impacted and reference areas of Wolf Lodge Creek following the spill. In addition, these indices tracked the progressive spatial recolonization of macroinvertebrates during the 16 month recovery period. All other indices tested failed to adequately quantify macroinvertebrate community response to the gasoline spill. (Author's abstract)
W88-10271

BIOCONCENTRATION AND METABOLISM OF BUTYLTIN COMPOUNDS IN CARP,
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
For primary bibliographic entry see Field 5B.
W88-10276

COMMUNITY HEALTH EFFECTS OF A MUNICIPAL WATER SUPPLY HYPERFLUORIDATION ACCIDENT,
For primary bibliographic entry see Field 5F.
W88-10279

PROGRESSIVE MODIFICATIONS IN THE STRUCTURE OF BENTHIC INVERTEBRATE COMMUNITIES AS A FUNCTION OF WATER QUALITY OF THE OURTHE AND LESSE (BELGIAN MEUSE) (MODIFICATION PROGRESSIVE DE LA STRUCTURE DES PEUPLEMENTS D'INVERTEBRES BENTHIQUES EN FONCTION DE LA QUALITE DE L'EAU DE L'OURTHE ET LA LESSE (MEUSE BELGE)),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. de Biologie Quantitative.
For primary bibliographic entry see Field 5A.
W88-10280

EFFECTS OF A SEWAGE TREATMENT PLANT ON THE PHYSICO-CHEMICAL QUALITY AND COMMUNITY STRUCTURE OF THE BENTHIC FAUNA OF A POLLUTED RIVER, THE HAUTE-SEMOIS (ETUDE DES EFFETS D'UNE STATION D'EPURATION SUR LA QUALITE PHYSICO-CHIMIQUE ET LA STRUCTURE DE PEUPLEMENT DE LA FAUNE BENTHIQUE D'UNE RIVIERE POLLUEE, LA HAUTE-SEMOIS),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. de Biologie Quantitative.
B. Jacques, E. Depeireux, and E. Feytmans.
Acta Oecologia, Oecologia Applicata AOSADN, Vol. 7, No. 3, p 261-279, March 1986. 7 fig, 3 tab, 36 ref.

Descriptors: *Water pollution effects, *Eutrophication, *Recolonization, *Wastewater disposal, *Organic loading, *Benthic fauna, Haute-Semois, Rivers, Invertebrate drift, River, Belgium, Multivariate analysis, Ecology, Bioindicators, Wastewater, Wastewater treatment, Water pollution, Physical properties, Chemical properties.

A sewage treatment plant was installed in order to purify the organic discharges which had been heavily polluting the upper stretch of the Haute-Semois River. Physico-chemical observations were gathered at different sites along the river before and after treatment began. The results indicate an obvious decrease in the values of the parameters that depend on the organic load along the first 10 kilometers below the plant and the disappearance of the daily pollution peak along the whole river.

This recovery from the organic pollution was observed one year as well as two months after the sewage treatment plant treatment began to function. In order to find out how this recovery has influenced the river's biological properties, quantitative samples of the benthic fauna were taken simultaneously. The results were treated using multivariate analysis which allows an easily interpretable description of the community structure. It also turned out that after a period of one year, no improvement of the river's biological properties was observed. No taxa typical of good water quality has shown up; certain stations were characterized by only quantitative changes. From the literature and additional observations, it follows that recolonization mechanisms seen to ensure the community reconstitution on the recovered sites (essentially by way of the drift from the tributaries). It is believed that the lack of recolonization is due to the bad influence of certain morphological characteristics of the river (canalization and paving) on the recovery of a rich and varied benthic fauna. (Author's abstract)
W88-10281

BEHAVIORAL RESPONSES OF RED HAKE, UROPHYCIS CHUSS, TO DECREASING CONCENTRATIONS OF DISSOLVED OXYGEN,
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Lab.
A. J. Bejda, A. L. Studholme, and B. L. Olla.
Environmental Biology of Fishes EBFID3, Vol. 19, No. 1, p 261-268, August 1987. 2 fig, 35 ref.

Descriptors: *Red hake, *Water pollution effects, *Fish behavior, *Dissolved oxygen, *Aging, *Oxygen requirements, *Oxygen depletion, Fish, Feeding, Hypoxia, Coastal waters, Marine environment.

Laboratory experiments were conducted to examine changes in behavior of red hake, Urophycis chuss, under decreasing concentrations of dissolved oxygen. Since the ecological requirements of this species change with age, responses were measured for three different groups: (1) age 0+ where the mean overall length (ml) = 89 mm, (2) age 1+ where the ml = 238 mm, and (3) age 2-3+ where the ml = 397 mm. As dissolved oxygen decreased from 8-10 mg/l to less than 0.5 mg/l, changes were evident in active time, water column activity, range of horizontal movement, food searching, and agonistic behavior. Age 0+ fish were most sensitive, moving up into the water column and swimming continuously as dissolved oxygen levels fell below 4.2 mg/l. Age 2-3+ fish were at least responsive, remaining on the substrate and increasing only their range of movement at concentrations below 3 mg/l. Responses of age 1+ fish were variable, possible reflecting a transition stage between the younger and older fish. Common to all groups was the decrease and eventual cessation of food searching. (Author's abstract)
W88-10285

HEAVY METAL LOAD OF LAKE IIDESJARVI AS REFLECTED IN ITS SEDIMENTS,
Helsinki Univ. (Finland). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-10287

PCB IN THE SEDIMENTS OF THE LAKE JYVASJARVI,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-10288

PHYTOPLANKTON IN LAKE KONNEVESI WITH SPECIAL REFERENCE TO EUTROPHICATION OF THE LAKE BY FISH FARMING,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. Eloranta, and A. Palomaki.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 37-45, 1987. 7 fig, 1 tab, 22 ref.

Descriptors: *Finland, *Lake Konnevesi, *Eutrophication, *Fish farming, *Phytoplankton, *Primary productivity, *Lakes, Spatial distribution, Oligotrophic lakes, Nutrients, Seasonal variation, Chlorophyta, Biomass, Chlorophyll a.

Phytoplankton community structure, biomass, chlorophyll a concentration, primary production in situ and in constant light and temperature were measured in Lake Konnevesi at 5 stations during the summer of 1985. During the late summer, the spatial distribution of the eutrophication by fish farm nutrients was measured at 10 more sampling stations in the eastern part of the lake. Lake Konnevesi is, in general, still oligotrophic. Overall averages of the measured variables were: (1) phytoplankton biomass at 437 mg/cu m, (2) chlorophyll a concentration at 4.6 mg/cu m, (3) phytoplankton primary production at 5000 lx and 20 C 104 mg C/sq m/d, and primary production in situ 177 mg C/sq m/d. The total phytoplankton primary production during the growing season was 12.5 g C/sq m. However, in the eastern part of the lake during the second half of the summer, all the variables increased significantly with the nutrient load from fish farms located on the upper part of the watercourse. According to late summer results, the eastern part of the lake can be classified as the mesotrophic type with: (1) the maximum phytoplankton biomass of 1311 mg/cu m, (2) maximum chlorophyll a concentration 16.9 mg/cu m, (3) primary production 'in vitro' of 328 mg C/cu m/d, and (4) the maximum phytoplankton primary production in situ of 366 mg C/sq m/d. Dominant phytoplankton species in the eutrophicated area was a chloromonad species, Gonyostomum semen, with the relative contribution of the total biomass of 36.7-43.8% and with the densities of 22-26 cells/ml in August 1985. (Author's abstract)
W88-10290

EUTROPHICATION OF LAKE LESTIJARVI AS A CONSEQUENCE OF FOREST BOG DITCHING,
Jyvaeskylae Univ. (Finland). Inst. for Environment Research.
For primary bibliographic entry see Field 4C.
W88-10292

AQUATIC MACROPHYTES IN THE SEA AREA AROUND THE LOVIISA NUCLEAR POWER STATION, SOUTH COAST OF FINLAND,
Finnish Centre for Radiation and Nuclear Safety, Helsinki.
E. Ilus, and J. Keskitalo.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 111-123, 1987. 7 fig, 4 tab, 31 ref.

Descriptors: *Gulf of Finland, *Thermal pollution, *Coastal waters, *Macrophytes, *Nuclear powerplants, *Water pollution effects, Seasonal distribution, Cooling water, Finland, Chlorophyta, Myriophyllum, Aquatic plant, Littoral environment, Water pollution, Baltic Sea.

The effect of thermal discharges on macrophytes was studied by scuba diving and dredging along permanent census transects in the sea area around the Loviisa nuclear power station in 1975-1982 and 1985. In general, the macrophyte vegetation increased in the discharge area after the power station started to operate in 1977. The increase can be attributed partly to the local thermal discharges and partly to the general increase of salinity and nutrients in the Gulf of Finland in the late seventies. An exception was formed by the transect nearest to the cooling water outlet (distance 150 m), where the vegetation was sparse in 1985. The effect of the thermal loading was observed to extend to a transect situated 1.8 km from the cooling water outlet. Prolongation of the growing season, due to the absence of ice in the late winter, has contributed to the increase of the vegetation in the discharge area. Filamentous green algae (especially Enteromorpha ahlneriana) were favored by the warm water current in the nearest vicinity of the cooling water outlet. Myriophyllum spicatum increased farther away from the outlet, forming a distinct belt on a transect situated at a distance of 0.7 km. In the early eighties, tall plants were generally covered with epiphytes such as Ectocarpus siliculosus and other filamentous algae. Fucus vesiculosus declined on three of the four transects. (Author's abstract)
W88-10297

SENSITIVITY OF SURFACE WATERS TO ACIDIC DEPOSITION IN FINLAND,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W88-10306

SUMMARY OF RESULTS FROM THE SWEDISH PROJECT 'ENVIRONMENT/CELLULOSE',
Lund Univ. (Sweden). Dept. of Ecology.
A. Sodergren, B.-E. Bengtsson, P. Johnsson, S. Lagergren, and A. Larson.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 49-60, 1988. 6 fig, 32 ref.

Descriptors: *Water pollution effects, *Sweden, *Waste disposal, *Pulp and paper industry, *Bleaching wastes, *Environmental effects, *Toxicity, Wastes, Industrial wastes, Fish, Environment, Aquatic environment, Effluents, Biomass, Species composition, Perch, Fish physiology, Animal physiology, Benthos, Sediments, Chlorine, Cellulose.

The biological effects of effluents from pulp industries, especially from bleaching processes, on aquatic ecosystems were studied. The principal study was devoted to the effects of biologically active chlorinated organic compounds. A receiving body of water for pulp bleach plant effluents at the Gulf of Bothnia was chosen for the three-year study. The fish biomass was low near the effluent outlet, and the species composition of the fish community had changed. Perch (Perca fluviatilis) exhibited reduced reproduction and disturbed physiology in all parts of the receiving water. The effluent also affected the diversity, biomass, and distribution of invertebrates and plants. Fish and benthic-living organisms were then exposed in the laboratory to sediment from the receiving water and to various mixtures of bleach plant effluents. The level of extractable organic chlorine (EOCl) of the perch decreased along a gradient from the effluent outlets towards the open sea. In sediment off the Swedish coast, the level of EOCl and the occurrence of compounds related to bleach mill effluents indicated a distribution of such substances over large areas. (Author's abstract)
W88-10314

RESTORATION OF SHALLOW LAKE ECOSYSTEMS, WITH EMPHASIS ON LOOSDRECHT LAKES,
Ministerie van Volkshuisvesting en Ruimtelijke Ordening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 5G.
W88-10341

LOOSDRECHT LAKES, ORIGIN, EUTROPHICATION, RESTORATION AND RESEARCH PROGRAMME,
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W88-10342

INTERACTION OF HYDROLOGICAL SYSTEMS AND EUTROPHICATION OF THE LOOSDRECHT LAKES,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2H.
W88-10343

MONTHLY MASS BALANCES FOR COMPARTMENTS OF THE LOOSDRECHT LAKES SYSTEM: APPROACH AND PRELIMINARY RESULTS,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2H.
W88-10344

FIRST STEP IN MODELLING PLANKTON GROWTH IN THE LOOSDRECHT LAKES,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 2H.
W88-10353

MATHEMATICAL MODELLING OF PRIMARY PRODUCTION IN GREEN BAY (LAKE MICHIGAN, USA), A PHOSPHORUS- AND LIGHT-LIMITED SYSTEM,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-10358

MICROBIOLOGICAL CHARACTERISTICS OF THE RIVER DUNAJEC WATERS IN THE SECTOR BETWEEN NOWY TARG AND NOWY SACZ (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W88-10368

ALGAE AND SOME BACTERIA IN THE PLANKTON OF THE RIVER MALA PANEW AND ITS TRIBUTARIES POLLUTED WITH INDUSTRIAL DISCHARGED WATERS (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
H. Bucka.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 121-138, 1986. 2 fig, 2 tab, 23 ref.

Descriptors: *Algae, *Bacteria, *Plankton, *Rivers, *Water pollution effects, *Stream Biota, *Species diversity, *Industrial wastewater, Wastewater, Heavy metals, Cyanophyta, Chlorophyta, Diatoms, Density, Population density, Water pollution, Euglenophyta, Scenedesmus, Bioindicators, Indicators, Poland.

The composition and abundance of algae in the strongly polluted River Mala Panew and its tributaries (Southern Poland) were investigated to determine the effects of industrial effluent from zinc smelting plants. High concentrations of heavy metals from these wastes were found to have a negative effect on the environment, facilitating the development of tolerant species (mainly Euglenales and some blue-green algae, including Oscillatoria) and those easily adaptable to the altered environmental conditions (certain diatoms and green algae). The diatom Synedra ulna was found at all stations. At polluted stations, the reduction in the number of taxa (particularly of the genera of diatoms) and a distinct decrease in population density were noted. Results confirm the use of Euglenales as good indicators of pollution. Filamentous green algae and Scenedesmus ecornis are presumed to contribute intensively to the process of self-purification in the water. (Doria-PTT)
W88-10369

EFFECT OF THE GOCZALKOWICE DAM RESERVOIR ON ZOOBENTHOS OF THE RIVER VISTULA (SOUTHERN POLAND),
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
E. Krzyzanek.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 1/2, p 215-225, 1986. 5 fig, 4 tab, 5 ref.

Descriptors: *Dam effects, *Environmental effects, *Benthic fauna, *Reservoirs, *Species composition, *Rivers, Aquatic animals, Dams, Benthos, Fauna, Poland, Biomass, Density, Population density, Hydraulic structures, Aquatic insects, Mayflies, Midges, Caddisflies, Vistula River.

The effects of the Goczalkowice dam reservoir on the composition of zoobenthos in the River Vistula (Southern Poland) were investigated at three stations: 3 km above the reservoir, 100 m below the dam, and 1,000 m below the dam. Although the period of investigation (1982-1983) was atypically dry, it was observed that even the small discharges that did occur from the reservoir affected the abundance and taxonomic composition of the zoobenthos. The zoobenthos of the station above the reservoir represents a relatively pure piedmont river, with an abundance of Ephemeroptera and increasing numbers of Chironomidae. At the second station, directly below the sluice, the decisive influence on zoobenthos is the water current. Here, 90% of the fauna were Chironomid larvae. The third station, 1,000 m below the sluice, was affected by the amount of water discharged from the reservoir as well as by the amount of stagnant water carried below the dam. Here the zoobenthos varied; Trichoptera and Chironomidae were dominant. It is concluded that the dam reservoir strongly affected the zoobenthos of the river, changing the community of bottom organisms from typically piedmont forms representing pure and oligotrophic waters into that of a eutrophic lowland river. (Doria-PTT)
W88-10372

COMMUNITIES OF SESSILE ALGAE IN THE RIVER DUNAJEC, ABOVE AND BELOW THE DAM RESERVOIRS OF ROZNOW AND CZCHOW (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. Sanecki.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 3/4, p 361-370, 1986. 2 fig, 2 tab, 17 ref.

Descriptors: *Algae, *Rivers, *Dam effects, *Reservoirs, *Species composition, *Bioindicators, *Water pollution effects, Hydraulic studies, Environmental effects, Water pollution, Water quality, Diatoms, Cladophora, Chlorophyta, Chrysophyta, Eutrophication, River Dunajes, Roznow Reservoir, Czcho Reservoir, Poland, Nitzschia.

Sessile algae of the River Dunajec were studied in the region of two dam reservoirs. Cladophora glomerata was dominant, along with diatoms. Above the reservoirs, where the river was polluted, Nitzschia palea and Navicula cryptocephala were the most common species. Sphaerotilus natans was also present. Below the reservoirs, the quality of the water improved; an increase in the number of diatom species was recorded, with a preponderance of Navicula viridula var. avenacea, N. gracilis, Nitzschia dissipata, and Achnanthes minutissima. The decreasing number of clean water species demonstrates the increasing pollution of the river. Results confirm that water quality is improved after passing through the reservoirs in which the uptake and settling of nutrients takes place. However, over the last 20 years the quality of the water in the region has deteriorated considerably, as indicated by the decreasing number of clean water species. It is concluded that prospects for water quality in the near future are poor. (Author's abstract)
W88-10379

BOTTOM INSECTS, CHIEFLY CHIRONOMIDAE, IN THE RIVER MALA PANEW AND ITS TRIBUTARIES POLLUTED WITH INDUSTRIAL WASTES (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. Zieba.
Acta Hydrobiologica (Cracow) AHBPAX, Vol. 28, No. 3/4, p 429-441, 1986. 1 fig, 2 tab, 16 ref.

Descriptors: *Aquatic insects, *Midges, *Rivers, *Water pollution effects, *Industrial wastes, *Benthos fauna, Insects, Tributaries, Wastes, Poland, Aquatic animals, Benthos, Fauna, Pulp wastes, Species composition, Heavy metals, River Mala Panew, River Stola, Species diversity, Self-purification, Graniczna Woda Stream.

The fauna of benthos insects in a sector of the River Mala Panew, strongly polluted with paper-mill wastes, was rather poor. Below the mouth of the tributary River Stola, which brought similar wastes and heavy metals, the noxious action of pollution was reduced by previous self-purification and dilution with the waters of other effluents. This locality was characterized by a considerable taxonomic differentiation of insects, approximating that found at the control station. The effect of greater concentrations of metals on the benthos in the Graniczna Woda stream was not always distinct. (Author's abstract)
W88-10380

BLINK REFLEX LATENCY AFTER EXPOSURE TO TRICHLOROETHYLENE IN WELL WATER,
Boston Univ., MA. School of Medicine.
For primary bibliographic entry see Field 5A.
W88-10389

WATER NITRATES AND CNS BIRTH DEFECTS: A POPULATION-BASED CASE-CONTROL STUDY,
Toronto Univ. (Ontario). Dept. of Preventive Medicine and Biostatistics.
T. E. Arbuckle, G. J. Sherman, P. N. Corey, D. Walters, and B. Lo.
Archives of Environmental Health AEHLAU, Vol. 43, No. 2, p 162-167, March/April 1988. 1 fig, 5 tab, 37 ref.

Descriptors: *Birth defects, *Nitrates, *Toxicity, *Water pollution effects, *Drinking water, *Population exposure, Statistical analysis, Chemical analysis, Water analysis, Multivariate analysis, Regression analysis, New Brunswick, Risks, Central nervous system, Canada, Public health, Well water.

The relation between maternal exposure to nitrates in drinking water and risk of delivering an infant with a central nervous system (CNS) malformation was examined by means of a case-control study in New Brunswick, Canada. The study revealed that the effect of nitrate exposure in water was modified by whether the source of the drinking water was a private well or a public municipal distribution system. Compared to a baseline nitrate level of 0.1 ppm, exposure to nitrate levels of 26 ppm from private well water sources was associated with a moderate, but not statistically significant, increase in risk (risk odds ratio = 2.30; 95% confidence interval = 0.73-7.29). If the source of drinking water was a municipal distribution system or a private spring, an increase in nitrate exposure was associated with a decrease in risk of delivering a CNS-malformed infant; however, these effect estimates were not stat*istically significant. The positive increase in risk with nitrate exposure from well water sources requires further study using a larger case series and a larger proportion of exposures to nitrate levels exceeding 5 ppm. (Author's abstract)
W88-10390

BLADDER CANCER IN MASSACHUSETTS RELATED TO CHLORINATED AND CHLORAMINATED DRINKING WATER: A CASE-CONTROL STUDY,
Brown Univ., Providence, RI. Dept. of Community Health.
S. Zierler, L. Feingold, R. A. Danley, and G. Craun.
Archives of Environmental Health AEHLAU, Vol. 43, No. 2, p 195-200, March/April 1988. 5 tab, 23 ref. US EPA Grant No. CR812080.

Descriptors: *Water pollution effects, *Toxicity, *Carcinogens, *Drinking water, *Risks, *Chlorination, *Population exposure, *Water quality management, Wastewater treatment, Bladder cancer, Lymphoma, Comparison studies, Massachusetts, Disinfection, Ammonia, Mortality.

Consumers of chlorinated drinking water have a small excess of bladder cancer. Risk may have been underestimated because of confounding and misclassification of exposure status. A case-control study was undertaken to address these problems. Detailed residential histories were obtained by telephone interviews with informants of 614 individuals who died of primarily bladder cancer and 1,074 individuals who died of other causes. Their surface water has been disinfected with chlorine or a combination of chlorine and ammonia (chloramine) since 1938. The mortality ratio for bladder cancer among individuals who resided only in

communities supplied with drinking water disinfected with chlorine, relative to individuals who resided only in communities supplied with drinking water disinfected with chloramine, was 1.6 (95% confidence interval = 1.2-2.1), using all controls; when the comparison group was restricted to individuals who died of lymphoma, the mortality odds ratio was 2.7 (95% confidence interval = 1.7-4.3). (Author's abstract)
W88-10392

BREEDING SUCCESS OF COMMON LOONS (GAVIA IMMER) IN RELATION TO ALKALINITY AND OTHER LAKE CHARACTERISTICS IN ONTARIO,
Trent Univ., Peterborough (Ontario). Dept. of Biology.
R. Alvo, D. J. T. Hussell, and M. Berrill.
Canadian Journal of Zoology CJZOAG, Vol. 66, No. 3, p 746-752, March 1988. 3 fig, 5 tab, 30 ref.

Descriptors: *Birds, *Water birds, *Alkalinity, *Lakes, *Loons, *Acid rain effects, *Acidic water, *Water pollution effects, Acid rain, Ontario, Hydrogen ion concentration, Mathematical analysis, Air pollution, Ecology, Statistical analysis, Color, Organoleptic properties, Environment, Aquatic environment, Water pollution effects, Rainfall.

The breeding success of common loons (Gavia immer) was examined and observations were made of loons feeding their young on small lakes (5.3-75 ha) with different alkalinities (-73 to 1,804 microeq/L) near Sudbury, Ontario. Alkalinity, pH, and conductivity were highly correlated with each other. There was a significant positive relationship between successful breeding and alkalinity on 68 lakes surveyed in 1982. Discriminant analysis showed that alkalinity, area, and color of the lake contributed significantly to discrimination among lakes with successful, unsuccessful, and no breeding attempts. Lack of a breeding attempt tended to be associated with small, brown, low-alkalinity lakes, and successful breeding with large, clear, high-alkalinity lakes. For lakes with breeding attempts in 1982-1984, alkalinity (all years), depth (1983), and area (1984) provided significant discrimination between unsuccessful lakes and those on which young were raised. Unsuccessful breeding resulted primarily from brood mortalities on acidic lakes. Adult loons were more successful at securing fish on high-alkalinity lakes than on low-alkalinity lakes, and this may reflect differences in fish densities. A pair of loons attempting to raise a chick on a fishless, acidic lake fed the chick benthic algae and possibly benthic invertebrates, but flew to other lakes to feed themselves. It is suggested that the high level of brood mortalities on acidic lakes resulted from a shortage of suitable food for the young. (Author's abstract)
W88-10413

USE OF THE PLANARIAN DUGESIA TIGRINA GIRARD FOR THE ASSESSMENT OF CHRONIC INTOXICATIONS,
Wyzsza Szkola Inzynierska, Zielona Gora (Poland). Inst. of Sanitary Engineering.
For primary bibliographic entry see Field 5A.
W88-10435

ASSESSMENT OF ROKANOL TOXICITY TO A POPULATION AND TO AN AQUATIC ECOSYSTEM,
Wyzsza Szkola Inzynierska, Zielona Gora (Poland). Inst. of Sanitary Engineering.
A. Solski, and E. Erndt.
Polskie Archiwum Hydrobiologii PAHYA2, Vol.34, No. 4, p 551-556, 1987. 5 fig, 5 tab, 20 ref. Inst. of Meteorology and Water Management Project PR-7.01.04.06.

Descriptors: *Toxicity, *Nonionic surfactants, *Detergents, *Bioassay, *Roxanol, *Water pollution effects, *Bioaccumulation, Pseudomonas, Scenedesmus, Aquatic plants, Aquatic populations, Aquariums, Ecosystems, Carp, Daphnia, Fish, Mortality, Median tolerance limit, Lethal limit.

Evaluation of the toxic effects of Rokanol (nonionic detergent) on the biota of surface waters were made through routine studies on a few species of aquatic organisms at the population level, as well as defined associations of aquatic organisms in flow-through aquariums. The value of the allowable concentration of Rokanol L-10 is 0.65 mg/L. This was estimated on the basis of the experimentally found 48-hr LC50 for Daphnia magna and the accepted safety coefficient of 0.1. Studies at the population level included the following species: Pseudomonas fluorescens, Scenedesmus quadricauda (Turp) Breb., Lemna minor L., Daphnia magna Straus., Cyprinus carpio L., and Poecilia reticulata Peters. The results obtained show a tendency of Rokanol to accumulate in the body of C. Carpio larvae. They also show that this detergent can be washed out or expelled. However, there is a considerable increase of toxicity in Rokanol water dilutions after 5 days (in 33% of the studies) and 7 days (in 67%) following the preparation of fresh dilutions. The effects of the allowable concentration of Rokanol and of concentrations twice and five times greater were observed in relation to associations of organisms which inhabit flow-through aquariums. The aquariums contained periphyton Lemna minor L., Ceratophylum demersum L., Daphnia magna Straus., Tubifex tubifex Mull. and Poecilia reticulata Peters. Twice the value of the found allowable concentration (1.30 mg/L) was proved to be non-toxic to organisms inhabiting flow-through aquariums during 4 weeks of exposure. (VerNooy-PTT)
W88-10436

EFFECT OF DOMESTIC SEWAGE ON THE STRUCTURE OF THE MICROBENTHIC CILIATE COMMUNITIES IN THE LYNA RIVER,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Water and Wastewater Biology.
M. Hull.
Polskie Archiwum Hydrobiologii PAHYA2, Vol.34, No. 4, p 567-578, 1987. 5 fig, 6 tab, 24 ref.

Descriptors: *Water pollution effects, *Wastewater, *Rivers, *Stream Biota, *Domestic wastes, Protozoa, Benthic fauna, Stream pollution, Ecosystems, Population density, Bacteriophage, Species composition, Poland.

Over a period of 20 months in 1974 and 1975 80 samples were collected from a 21 km stretch of the Lyna River, polluted with domestic sewage. Sampling stations were located in a clean sector of the river, a strongly polluted one, and a sector of progressive self-purification. 152 taxa were identified in the 80 samples. The effect of sewage on ciliate communities was reflected in the elimination of 10% of the species, a 20-fold increase of the community densities, and 30-fold increase of the range of variation in ciliate numbers. High densities of the communities were essentially due to strong development of several species persisting in the environment for most of the year. Sewage pollution also induced mass development of the organisms feeding on bacteria, which are indicators of high pollution. Domination and frequency patterns changed according to the saprobic state of the bottom communities of the ciliates. The self-purification process in the Lyna River below Olsztyn was reflected in increasing structural similarity of the communities to that observed in natural waters. (VerNooy-PTT)
W88-10437

COMMUNITY METABOLISM IN NATURAL AND AGRICULTURALLY DISTURBED RIFFLE SECTIONS OF THE CHIPPEWA RIVER, ISABELLA COUNTY, MICHIGAN,
Central Michigan Univ., Mount Pleasant.
S. S. Brown, and D. K. King.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 39-51, June 1987. 5 fig, 2 tab, 23 ref.

Descriptors: *Metabolism, *Riffles, *Stream biota, *Agricultural watersheds, *Water pollution effects, Photosynthesis, Respiration, Particulate matter, Organic matter, Diatoms, Chlorophyta, Aquatic populations, Seasonal variation, Michigan.

Estimates of aquatic community metabolism were made seasonally (1983-1984) at three sites representing an agricultural gradient along the Chippewa River. Agricultural land-use was found to have a strong negative impact on stream metabolism. Annual mean photosynthesis/respiration ratios (P/R), monitored with an in situ chamber method, demonstrated an autotrophic-heterotropic shift consistent with increased farming intensity (P/R=1.31 vs 1.08 vs 0.64). Other productive and consumptive parameters supported those trends summarized in the P/R values. Within-site seasonal measurements indicated summer maxima and winter minima. Particle-sized organic content (AFDW) was determined for chamber sediments in order to locate the source of oxygen metabolism. While productive sections maintained populations of epilithic diatoms and filamentous green algae on relatively large substrates, the most disturbed site was heterotrophically dominated by very small particles. (Author's abstract)
W88-10451

BENTHOS IN BEAR CREEK, MISSISSIPPI: EFFECTS OF HABITAT VARIATION AND AGRICULTURAL SEDIMENTS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
C. M. Cooper.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 101-113, June 1987. 3 fig, 3 tab, 17 ref.

Descriptors: *Benthic fauna, *Agricultural runoff, *Water pollution effects, *Aquatic habitats, *Macroinvertebrates, *Stream biota, *Oxbow lakes, Sedimentation rates, Secondary productivity, Oligochaetes, Midges, Suspended sediments, Chaoborus, Species diversity, Water quality, Mississippi.

The macroinvertebrate fauna of Bear Creek, a 83 km stream which flows through six oxbow lakes, and two off-stream lakes in the same watershed, was studied for two years. Bear Creek, a tributary of the Yazoo River in the Delta region of Mississippi, drains 330 sq km of intensively cultivated agricultural land and carries a continuing sediment concentration during the rainy season of up to 1300 mg/L. Benthic organisms were collected monthly from August, 1976 through August, 1978 at six stream stations and at 14 lake stations, across a variety of substrates, and at depths ranging from 0.5 to 6.5 m. In most lake and stream sections of the creek, Chaoborus (one species), Chironomidae (nineteen genera), and Oligochaeta (three species), dominated the benthos. Thirteen other genera of insects were represented, as were Bryozoa (four genera), Mollusca (nine genera), Hirudinea (five genera), and Crustacea (three genera). There was continuous stress from high rates of sedimentation (up to seven cm/yr) as indicated by low taxa richness and diversity at a majority of stations sampled. Most creek stations were subject not only to annual sedimentation and flushing but also to fluctuations in water level and drying. Secondary productivity varied greatly (1 to 31 g dry wt/sq m/yr) and was almost totally dependent on three taxa of pollution tolerant organisms except in unstressed stream reaches. Low productivity in riverine lakes, when compared to stream sections was partially due to differences in species distribution in lotic and lentic habitats. The mayfly Hexagenia bilineata, the clam Sphaerium rhomboideum, and the bryozoan Pectinatella magnifica, responded negatively to environmental stresses induced by seasonally high concentrations of suspended sediments. (Author's abstract)
W88-10456

EVALUATION OF AN AQUATIC ECOREGION CLASSIFICATION OF STREAMS IN ARKANSAS,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W88-10458

VARIABILITY IN THE SPERMATHECAL SETAE OF POTAMOTHRIX HEUSCHERI (BRETSCHER) (OLIGOCHAETA, TUBIFICIDAE) IN LAKE NEMI AND NOTES ON THE RELATIONSHIP BETWEEN THIS SPECIES AND THE TROPHIC LEVEL OF LAKES (VARIABILITE DES SOIES SPERMATHECALES DE

POTAMOTHRIX HEUSCHERI (BRETSCHER) (OLIGOCHAETA, TUBIFICIDAE) DANS LE LAC DE NEMI ET REMARQUES SUR LA RELATION ENTRE CETTE ESPECE ET LE DEGRE DE TROPHIE DES LACS),
Rome Univ. (Italy). Dept. of Animal and Human Biology.
For primary bibliographic entry see Field 2H.
W88-10464

OLIGOCHAETES OF A RIVER IN THE SOUTH ALPS, THE BUECH (LES OLIGOCHETES D'UNE RIVIERE DES ALPES DU SUD, LE BUECH),
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
A. Vedovini, P. Legier, and F. Vespini.
Annales de Limnologie ANLIB3, Vol. 21, No. 2, p 117-125, 1985. 5 fig, 3 tab, 13 ref.

Descriptors: *Oligochaetes, *Ecology, *Eutrophication, *Mountain streams, *Water pollution effects, France, Population Density, Aquatic animals, Animal populations, River Buech, Alps.

In the River Buech (France), the oligochaete community has a relatively high number of species whereas the population density is quite low. The relative frequency of the four families present shows a marked dominance of the Naididae. The physical factors (gravels) are responsible for the low numbers in the population whereas the chemical factors (effluents of waste water) have the opposite effect on the Naididae. The structure and density of the communities at the stations subjected to the chemical factors show that the latter remain at the level of simple eutrophication. (Author's abstract)
W88-10465

MOLLUSKS OF TIGNES LAKE (SAVOIE): THEIR USEFULNESS IN CHARACTERIZING WATER QUALITY IN HIGH ALTITUDE LAKES (LES MOLLUSQUES DU LAC DE TIGNES (SAVOIE): INTERET DE CE GROUPE FAUNISTIQUE POUR CARACTERISER LA QUALITE BIOLOGIQUE DES SEDIMENTS DES LACS D'ALTITUDE,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France).
For primary bibliographic entry see Field 5A.
W88-10477

PRODUCTIVITY RESPONSES OF PERIPHYTON AND PHYTOPLANKTON TO BLEACH-KRAFT MILL EFFLUENT,
North Texas State Univ., Denton. Dept. of Biological Sciences.
T. M. Davis, B. D. Vance, and J. H. Rodgers.
Aquatic Toxicology AQTODG, Vol. 12, No. 2, p 83-106, February 1988. 7 fig, 6 tab, 40 ref.

Descriptors: *Kraft mills, *Water pollution effects, *Periphyton, *Bleaching wastes, *Pulp wastes, *Primary productivity, *Phytoplankton, Effluents, Light penetration, Chlorophyll a, Algae, Water pollution, Sulphur River, Texas, Arkansas, Mill effluents, Productivity.

Responses of periphyton and phytoplankton productivity in the lower Sulphur River (Texas-Arkansas) to bleach-kraft mill effluent were monitored using in situ C-14 incubation. Periphyton productivity was not significantly decreased downstream of the mill discharge nor were periphyton productivity efficiences. The community structure of the periphyton community shifted toward heterotrophic population near the mill discharge but recovered to upstream characteristics at downstream stations. Phytoplankton primary productivity and productivity efficiency were significantly decreased downstream of the mill discharge. These decreases were associated with increased light attenuation downstream due to the mill effluent. Chlorophyll a concentrations of periphyton and phytoplankton were not significantly altered by the mill effluent; therefore, the effluent was not lethal to the algae. Significant inverse relationships found with increased light attenuation indicators (Epsilon and selected water chemistry) indicated that light availability was associated with changes in C-14 rates. (Author's abstract)
W88-10495

EFFECTS OF COPPER ON DEVELOPMENT OF THE FATHEAD MINNOW, PIMEPHALES PROMELAS RAFINESQUE,
Geological Survey, Menlo Park, CA. Water Resources Div.
B. C. Scudder, J. L. Carter, and H. V. Leland.
Aquatic Toxicology AQTODG, Vol. 12, No. 2, p 107-124, February 1988. 2 fig, 5 tab, 38 ref.

Descriptors: *Copper, *Fathead Minnows, *Fish, *Toxicity, *Water pollution effect, Water pollution, Embryonic growth stage, Developmental rate, Early life stage, Heavy metals.

Embryos of the fathead minnow, Pimephales promelas Rafinesque, were exposed to total copper concentrations of 0.6, 61, 113, 338 and 621 micrograms/liter from 5 to 10 hours post-fertilization through 2 days post-hatch. A decrease in hatching time was observed with increasing total copper concentration but there was no decrease in embryonic developmental rate. Therefore, embryos hatched at earlier stages of development. Significant declines in percent total hatch were observed at 621 micrograms/liter copper concentration but not at 338 micrograms/liter copper concentration or lower concentrations. The percentage of embryos with abnormalities was greater at 338 and 621 micrograms/liter copper concentration than at 204 micrograms/liter copper concentration and lower concentrations. Individuals exposed to copper during early development were then exposed to the same test concentrations for 28 days post-hatch. Survivors at 113 through 338 micrograms/liter copper concentration were at earlier stages of development than were control fish. The percentage of fish surviving decreased with increasing copper concentration over the range 61 through 204 micrograms/liter copper concentration. The percentage of fish surviving at 204 micrograms/liter copper concentration was not significantly different from that at 338 micrograms/liter Copper concentration. Surviving larvae at all copper concentrations from 61 through 621 micrograms/liter copper concentration showed decreased length, weight and coefficient of condition compared to controls. The percentage of larvae with abnormalities increased significantly with increasing copper concentration. The calculated 96-hour LC50 (larval stage) was 250 micrograms/liter Copper concentration and the 28-day LC50 (larval stage) was approximately 123 micrograms/liter copper concentration. (Author's abstract)
W88-10496

PLASMA ACID-BASE AND ELECTROLYTE STATES OF RAINBOW TROUT EXPOSED TO ALUM (ALUMINUM SULFATE) IN ACIDIC AND ALKALINE ENVIRONMENTS,
Alberta Environmental Centre, Vegreville.
T. A. Heming, and K. A. Blumhagen.
Aquatic Toxicology AQTODG, Vol. 12, No. 2, p 125-140, February 1988. 5 tab, 30 ref.

Descriptors: *Acid rain effects, *Aluminum, *Acidic water, *Trout, *Toxicity, *Water pollution effects, Alum, Aluminum sulfate, Hydrogen ion concentration, Electrolytes, Alkaline water, Water pollution, Rainbow trout, Electrolyte hemeostasis, Plasma acid-base.

The effects of alum (aluminum sulfate) on the ability of rainbow trout to regulate their plasma acid-base and electrolyte states were investigated in the face of acidic and alkaline shifts in water pH. At water pH 4.3, alum exacerbated plasma acid-base and electrolyte disturbances and decreased fish survival, in a concentration-dependent manner. The threshold for no acute effect was below 0.5 mg/l (0.05 mg/l Al). At water pH 7.8, alum to 10 mg/l (0.91 mg/l Al) had no detectable effect on plasma characteristics or fish survival. At water pH 8.7, alum concentrations < or = 1 mg/l (0.09 mg/l Al) ameliorated plasma acid-base and electrolyte disturbances and increased fish survival, relative to the effects observed without alum. Thus at pH 8.7, low concentrations of alum protected the fish from the effects of base exposure. Alum concentrations . or = 10 mg/l (0.91 mg/l Al) at pH 8.7 exacerbated plasma electrolyte disturbances and reduced fish survival. These results are probably reflective of the toxic effects of Al(OH)4(-). The threshold for no acutely toxic effect of Al(OH)4(-) appeared to lie between 0.45 and 0.91 mg/l Al. (Author's abstract)
W88-10497

EFFECT OF DIETARY EXPOSURE TO AROCLOR 1254 AND/OR MIREX ON HUMORAL IMMUNE EXPRESSION OF RAINBOW TROUT (SALMO GAIRDNERI),
McMaster Univ., Hamilton (Ontario). Dept. of Pathology.
G. B. Cleland, P. J. McElroy, and R. A. Sonstegard.
Aquatic Toxicology AQTODG, Vol. 12, No. 2, p 141-146, February 1988. 3 tab, 14 ref.

Descriptors: *Trout, *Pesticides, *Water pollution effects, *Aroclors, *Toxicity, Water pollution, Diets, Mirex, Dietary exposure, Brown trout.

Diets containing three concentrations of Aroclor 1254 (3, 30, and 300 ppm) or mirex (0.5, 5, and 50 ppm) and a mixture of Aroclor 1254 (30 ppm) plus mirex (5 ppm) were fed to juvenile rainbow trout (Salmo gairdneri) for 12 months. Generalized toxic effects were assessed by weight loss and hepatomegally. Humoral immunomodulation was assessed by the plaque forming cell response to sheep red blood cells. Body wasting was observed following dietary exposure to the highest concentration of Aroclor 1254 and to the diet containing Aroclor 1254 plus mirex. Hepatomegaly occurred at the highest dose of Aroclor 1254. The trout plaque forming cell response to sheep red blood cells was not significantly altered during a 12 month exposure to Aroclor 1254- and/or mirex-containing diets. (Author's abstract)
W88-10498

RELATIONSHIPS BETWEEN THE STRUCTURES OF CHLORINATED PHENOLS, THEIR TOXICITY, AND THEIR ABILITY TO INDUCE GLUTATHIONE S-TRANSFERASE ACTIVITY IN DAPHNIA MAGNA,
University of South Florida, Tampa. Dept. of Biology.
G. A. LeBlanc, B. Hilgenberg, and B. J. Cochrane.
Aquatic Toxicology AQTODG, Vol. 12, No. 2, p 147-156, February 1988. 3 fig, 2 tab, 19 ref. NIH Grant GM30891 and NIH Biomedical Research Support Grant SO7-07121.

Descriptors: *Chlorinated hydrocarbons, *Toxicity, *Daphnia, *Phenols, *Water pollution effects, Enzyme activity, Glutathione S-transferase, Crustaceans, Detoxification, Enzymes, Water pollution.

The effects of six chlorinated phenols on Daphnia magna were assessed with respect to acute toxicity, as well as to their abilities to induce activity of the chemical detoxification enzyme glutathione S-transferase. Toxicities were demonstrated to be directly related to lipophilicity, with those compounds having higher numbers of chlorine substitutions being more toxic. All of these compounds induced enzyme activity; however, there was no evident relationship between compound structure and potency as an inducer. It is suggested that in fact all of these compounds act in a similar manner internally to modulate enzyme activity, and that apparent differences in activity are a reflection of differences in bioconcentration of the different compounds. (Author's abstract)
W88-10499

EFFECT OF SODIUM ISOPROPYLXANTHATE, POTASSIUM AMYLXANTHATE AND SODIUM DIETHYLDITHIOCARBAMATE ON THE UPTAKE AND DISTRIBUTION OF CADMIUM IN THE BROWN TROUT (SALMO TRUTTA),
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Pharmacology and Toxicology.

J. Gottofrey, I. Bjorklund, and H. Tjalve.
Aquatic Toxicology AQTODG, Vol. 12, No. 2, p 171-184, February 1988. 4 fig, 3 tab, 19 ref.

Descriptors: *Thiocarbamate pesticides, *Path of pollutants, *Industrial wastes, *Cadmium, *Fish, *Water pollution effects, Heavy metals, Xanthates, Dithiocarbamates, Brown trout, Toxicity, Trout, Absorption, Water pollution, Chelating agents.

Brown trout, Salmo trutta, were exposed to water containing 1 microg/l of (109)Cd(+2), alone or with sodium isopropylxanthate, potassium amylxanthate or sodium diethyldithiocarbamate, respectively. After one week, the uptake and distribution of the (109)Cd(+2) in the fish were examined by whole-body autoradiography and gamma spectrometry. Sodium diethyldithiocarbamate was found to enhance the uptake of the (109)Cd(+2) in several tissues of the fish and this effect increased with increasing concentration of the carbamate. Potassium amylxanthate induced increase in the levels of (109)Cd(+2) in several tissues, whereas the brain was the only tissue with increased concentration of (109)Cd(+2) in the presence of sodium isopropylxanthate. A likely mechanism for the enhanced uptake of the (109)Cd(+2) may be a facilitated penetration over the gill membranes of the lipophilic complexes formed between the studied compounds and the cadmium. A facilitated passage through cellular membranes may also be important for the increased uptake of the metal in other tissues. An elevated uptake of cadmium by the xanthates or the diethyldithiocarbamate may constitute an increased risk for noxious effects of the metal. (Author's abstract)
W88-10500

ACUTE TOXICITY OF ALDEHYDES TO THE GUPPY,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
J. W. Deneer, W. Seinen, and J. L. M. Hermens.
Aquatic Toxicology AQTODG, Vol. 12, No. 2, p 185-192, February 1988. 1 fig, 1 tab, 19 ref.

Descriptors: *Toxicity, *Aldehydes, *Guppies, *Fish, *Water pollution effects, Water pollution.

The acute toxicity, 14 day LC(50), of several aldehydes to the guppy (Poecilia reticulata) was investigated, establishing a quantitative structure-activity relationship. The toxicity is found to be described satisfactorily by a quantitative structure-activity relationship employing hydrophobicity as the only parameter. Compounds possessing carbon-carbon double bonds are more toxic than predicted on the basis of this quantitative structure-activity relationship. As the hydrophobicity of the tested compounds increases, their LC(50)values gradually shift towards values that are expected on the basis of narcotic action. A possible explanation for this phenomenon is given in terms of the distribution of the compound over the lipid and aqueous phases within the organism. (Author's abstract)
W88-10501

ESTIMATION OF A SINGLE PROBIT LINE FROM MULTIPLE TOXICITY TEST DATA,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
W. Hong, P. G. Meier, and R. A. Deininger.
Aquatic Toxicology AQTODG, Vol. 12, No. 3, p 193-202, March 1988. 2 fig, 3 tab, 7 ref.

Descriptors: *Pesticides, *Toxicity, *Bioassay, *Data interpretation, Data processing, Effluents, Diquat, Water pollution effects, Water pollution, Fish, Fathead minnows, Probit analysis, Water quality standards, Estimating.

A procedure for combining probit lines from several toxicity tests was developed by modifying the maximum likelihood probit method to include the technique for parallel line probit analysis. The resulting single probit line from this method is referred to as a 'grand probit line' and takes into account separate test results. To ease the calculation, a BASIC program was developed for an IBM PC. The program outputs are: (1) a grand probit line equation, (2) LC(50) and its associated 95% confidence interval, (3) two hypothesis test results, and (4) a graphical display of the grand probit line on the screen. The toxicity data used were obtained from tests performed for the determination of 48 hour LC(50) of diquat on fathead minnows, Pimephales promelas. (Miller-PTT)
W88-10502

SITE-SPECIFIC BARIUM TOXICITY TO COMMON DUCKWEED, LEMNA MINOR,
Illinois State Water Survey Div., Peoria. Water Quality Section.
W. Wang.
Aquatic Toxicology AQTODG, Vol. 12, No. 3, p 203-212, March 1988. 4 fig, 3 tab, 20 ref. EPA R810834.

Descriptors: *Heavy metals, *Water pollution effects, *Barium, *Toxicity, *Duckweed, Water quality, Water quality standards, Macrophytes, Regression analysis, Sites, Water pollution, Water sampling, Sulfates, Hayes Creek, Horseshoe Lake, Illinois.

The barium water quality standard for indigenous aquatic life in Illinois is 5 mg/l in total form. This study was conducted to test Ba phytotoxicity in various water samples, encompassing lake and stream waters with a wide variation in water quality. A total of 59 samples were collected from 18 stations. Common duckweed, Lemna minor, was used as the test organism. The results show that Ba toxicity to duckweed was highly dependent on site-specific water quality. The Ba ion was most toxic to duckweed in waters from Hayes Creek and Horseshoe Lake, with 50% growth inhibition at concentrations 102 and 107 mg/l Ba, and least toxic in Beaucoup Creek, 0-6% growth inhibition at 400 mg/l Ba. The major factor modifying Ba toxicity was the sulfate concentration in the water samples. Regression analysis showed that the relationship between them was linear with the coefficient of determination = 0.68. The current water quality standard of 5 mg/l Ba (total) is considered adequate to protect common duckweed in all waters tested. (Author's abstract)
W88-10503

RELATIONSHIPS BETWEEN SUBCELLULAR DISTRIBUTIONS OF CADMIUM AND PERTUBATIONS IN REPRODUCTION IN THE POLYCHAETE NEANTHES ARENACEODENTATA,
California State Univ., Long Beach. Molecular Ecology Inst.
K. D. Jenkins, and A. Z. Mason.
Aquatic Toxicology AQTODG, Vol. 12, No. 3, p 229-244, March 1988. 6 fig, 1 tab, 37 ref.

Descriptors: *Path of pollutants, *Cadmium, *Polychaetes, *Water pollution effects, *Heavy metals, *Reproduction, Accumulation, Metabolism, Ions, Water pollution.

The accumulation and subcellular distribution of Cd in the polychaete worm, Neanthes areanceodentata, were examined following an eleven-week period of exposure to a range of free cadmium ion activities. The accumulation of Cd in N. arenaceodentata was directly proportional to Cd(+2) in seawater at lower concentrations (10 to the minus 12th power M to 10 to the minus 10th power M) but deviated from proportionality at higher concentrations (10 to the minus 9th power M and 10 to the minus 8th power M). This deviation in proportionality at higher Cd(+2) levels was attributable to a relative increase in the concentration of metal associated with the metallothionein and the very low molecular weight metal-ligand pools of the cytosol. Reproductive potential was also monitored in these organisms to examine the ecological significance of Cd accumulation and shifts in its subcellular distribution. Pertubations in reproduction were observed at 10 to the minus 8th power M for Cd(+2) which coincided with the deviation in proportionality of Cd accumulation and increased accumulation of Cd in the cytosol. (Author's abstract)
W88-10505

TOXICOKINETICS OF ORGANIC XENOBIOTICS IN THE AMPHIPOD, PONTOPOREIA HOYI: THE ROLE OF PHYSIOLOGICAL AND ENVIRONMENTAL VARIABLES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
P. F. Landrum.
Aquatic Toxicology AQTODG, Vol. 12, No. 3, p 245-271, March 1988. 9 fig, 8 tab, 53 ref.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *Water pollution effects, *Toxicity, *Kinetics, *Amphipods, Temperature effects, Physiological ecology, Seasonal variation, Environmental effects, Hydrocarbons, Water pollution effects, Toxicokinetics, Crustaceans, Accumulation.

The accumulation and elimination kinetics of selected aromatic hydrocarbons and polychlorinated biphenyl congeners were determined for the amphipod, Pontoporeia hoyi, the major benthic invertebrate in the Great Lakes. Rates measured during the course of several field seasons, along with the environmental and physiological variables, indicated that for compounds less water soluble than anthracene, the uptake rate constant (K sub u) is inversely proportional to the mass of the organisms and directly proportional to experimental temperature. The role of temperature was again limited to the more water insoluble compounds. The depuration rate constant was inversely proportional to the octanol-water partition coefficient, the mass of the organism and the lipid content of the organisms. Depuration Rate was directly proportional to temperature although the effect of temperature was again insignificant for the very water soluble biphenyl. The magnitude of the thermal effect was lower during the summer and early fall when the lipid content of the organisms was high. Both the uptake and elimination kinetics are dependent on a variety of physiological and environmental factors. The kinetic parameters must be normalized for the various factors before comparisons of kinetics in P. hoyi between collections at different times during the year and different sampling sites can be made. (Author's abstract)
W88-10506

EFFECTS OF WATER HARDNESS AND HUMIC ACID ON ZINC TOXICITY TO DAPHNIA MAGNA STRAUS,
Miami Univ., Oxford, OH. Dept. of Zoology.
J. D. Paulauskis, and R. W. Winner.
Aquatic Toxicology AQTODG, Vol. 12, No. 3, p 273-290, March 1988. 8 fig, 5 tab, 41 ref. EPA Environmental Research Lab Cooperative Agreement No. 809224010.

Descriptors: *Daphnia, *Toxicity, *Zinc, *Hardness, *Humic acids, *Water pollution effects, Water pollution, Heavy metals, Crustaceans.

The effect of water hardness and humic acid on the acute and chronic toxicity of zinc to Daphnia magna were evaluated. Increases in either water hardness or humic acid concentration resulted in proportional decreases in both acute (3-day) and chronic (50-day) zinc toxicity. The effect of either variable was independent of the other in acute tests. In chronic tests, humic acid reduced the toxic effect of zinc on reproduction more in soft water than in hard water. In addition to reducing the chronic toxicity of zinc, the data suggest that an increase in water hardness also changes the mode of chronic toxic action of zinc. As previously shown for other metals, this study indicates that a reliance on only reproductive and survival endpoints in short-duration chronic tests may lead to an underestimation of the chronic toxicity of zinc. (Author's abstract)
W88-10507

EFFECTS OF HEAVY METALS ON LIPID METABOLISM IN MARINE ALGAE,
University Coll., Cardiff (Wales). Dept. of Biochemistry.
For primary bibliographic entry see Field 5A.
W88-10517

ACCUMULATION OF COPPER AND COBALT BY BLUE-GREEN ALGAE AT DIFFERENT TEMPERATURES,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-10541

SURVEY OF THE FISHES AND MACROINVERTEBRATES OF SOME SMALL STREAMS IN COOK, LAKE, AND DUPAGE COUNTIES, ILLINOIS,
Memphis State Univ., TN. Dept. of Biology.
O. T. Gorman.
Transactions of the Illinois Academy of Science TISAAH, Vol. 80, No. 3-4, p 253-272, 1987. 1 fig, 4 tab, 33 ref. Illinois Department of Transportation Project FAP-426.

Descriptors: *Aquatic ecosystems, *Fish, *Macroinvertebrates, *Aquatic insects, *Streams, *Water quality, *Water pollution, *Illinois, Urban planning, Headwaters, Bioindicators, Chicago, Time series analysis.

A survey of the fishes and macroinvertebrates of 6 Chicago-area streams in Illinois was conducted in 1984-85. The fauna were typical of highly disturbed and enriched streams; at most sites the number of individuals and species was low and intolerant species were not collected. A total of 17 fish species were not collected. A total of 17 fish species representing 6 families, and 20 aquatic insect genera representing 14 families was collected. Karr's index of biotic integrity indicated that the fish fauna of most of the streams sampled were of poor to very poor quality. Similar results were obtained for the aquatic insect fauna with Hilsenhoff's biotic index. A comparison of records of Chicago-area fishes from the late 19th and early 20th century with contemporary post-1950 records, shows massive changes in the composition of the region's fish fauna in the past 100 years. These changes appear to be a consequence of the widespread disturbance and pollution of streams that accompanied the development of the Chicago region. Stream biotas can contribute significantly to downstream water quality by processing nutrients received from runoff, but without a thriving biota, headwater streams function merely as conduits. By disrupting the establishment and function of stream biotas, continued perturbation of headwater streams and their watersheds in the Chicago area may prevent the achievement of future water quality goals for the region. (Author's abstract)
W88-10553

EFFECT OF RAINWATER QUALITY ON SOIL WATER AND SOIL PROPERTIES,
Finnish Forest Research Inst., Helsinki. Dept. of Forest Genetics.
J. Derome.
Aquilo, Ser. Botanica ASBOD8, Vol. 25, No. 1, p 4-12, 1987. 4 fig.

Descriptors: *Acid rain, *Aluminum, *Potassium, *Decomposing organic matter, *Cation exchange, *Forest soils, Soil properties, Soil water, Finland, Artificial precipitation, Hydrogen ion concentration.

Determination of the so-called acid neutralization capacity (ANC) was performed on humus samples taken from a total of 46 sample plots established on mineral soil sites of different site type in southern and central Finland. The purpose laboratory analyses aimed to estimate the capacity of the soil, in this case the humus layer, to neutralize added hydrogen ions. The cation liberated (exchanged) in the greatest amounts upon acid addition is calcium, followed by manganese, magnesium and potassium in considerably smaller amounts. The amount of aluminum and iron exchanged is insignificant. When the proportion of the individual cations exchanged out of the total amount of the individual exchangeable cations (determined by extraction with ammonium acetate, pH 4.65) is plotted versus pH, the divalent cations (Ca, Mg and Mn) form one group, and the trivalent cations (Fe and Al) another. The behavior of K still differs from that predicted by classical cation exchange theory. These studies indicate that the liberation of potassium from the exchange sites in the humus layer is relatively independent of the amount of hydrogen ions present, i.e., the pH. the results of these simulation experiments indicate that most of the so-called exchangeable potassium in the humus layer is not liable to be subject to leaching losses as a result of acid precipitation, and that the aluminum in the humus layer is very strongly bound to the exchange sites and is not liberated in significant quantities until the pH of the humus falls below 3. (Author's abstract)
W88-10557

INFLUENCE OF EVAPOTRANSPIRATION AND PRECIPITATION ON LONG-TERM CHANGES IN EXCHANGEABLE BASE CATIONS IN FOREST SOIL (METSAMAAN VESITALOUDEN VAIKUTUKSESTA EMASKYLLASTY SASTEEN PITKAAIKAISIIN MUUTOKSIIN),
Helsinki Univ. (Finland).
M. Holmberg, and P. Hari.
Aquilo, Ser. Botanica ASBOD8, Vol. 25, No. 1, p 13-19, 1987. 4 fig, 1 tab, 11 ref.

Descriptors: *Leaching, *Soil genesis, *Acid rain, *Forest soils, *Weathering, *Cation exchange, *Evapotranspiration, Model studies, Minerals, Precipitation, Simulated rainfall, Hydrogen ion concentration, Podzolization, Salinization.

Mineral weathering and cation exchange are the primary neutralizing processes in forest soils. In the long run the rate of mineral weathering, the amount of exchanging surface and the hydrological conditions of the site determine the response of a certain soil to changes in the incoming mass fluxes. A dynamic model based on theoretical considerations of the mass fluxes in forest soil has been used to illustrate the influence of evapotranspiration and leaching on changes in the ion concentrations on the exchange sites. The impact of a hydrogen ion deposition pattern showing a peak of 26 meq/sq m/a in the year 1980 was simulated with a model based on the assumptions that: (1) the rate of cation exchange depends on the equivalent concentrations of ions in soil solution and on the exchange sites; (2) the rate of weathering is constant; and (3) the rate of water percolating through the soil equals precipitation minus evapotranspiration. Simulating an annual precipitation of 600 mm and varying the rate of evapotranspiration from 100 to 600 mm/a showed that the response is not a monotonic function of the evapotranspiration rate. A minimum in the time required for a 30% decrease in exchangeable base cations and a maximum in the change occurring within 40 years was reached with an annual evapotranspiration of 480 mm. The results illustrate the processes of podzolization and salinization. Although no empirical verification has been performed so far, the force of the model lies in its ability to distinguish under which hydrological conditions soil changes first ought to be noticeable, and where the largest percolation of ions to groundwater may occur. (Author's abstract)
W88-10558

INTERACTIVE EFFECT OF POTASSIUM DEFICIT AND ACID RAIN ON PHOTOSYNTHESIS OF SCOTS PINE SEEDLINGS (KALIUMIN PUUTTEEN JA HAPPAMAN SATEEN YHTEISVAIKUTUS MANNIN FOTOSYNTEESIIN),
Helsinki Univ. (Finland).
P. Nygren, and P. Hari.
Aquilo, Ser. Botanica ASBOD8, Vol. 25, No. 2, p 129-135, 1987. 3 fig., 4 ref.

Descriptors: *Acid rain, *Photosynthesis, *Pine trees, *Water pollution effects, *Seedlings, *Assimilative capacity, *Carbon, Conifers, Potassium deficit, Plant physiology, Plant pathology, Deficient elements, Simulated rainfall, Regression analysis, Model studies, Plant growth.

The dilution of carbon dioxide into solution is reduced when the acidity of the solution increases. Thus acid rain apparently hampers the carbon assimilation of plants if the buffering ability of the mesophyll tissue is disturbed. Preliminary results of an experiment to test the hypothesis that potassium has an important regulatory role in the pH control of the mesophyll solution are briefly presented. Four Scots pine seedlings were grown in different potassium availabilities. Other nutrients were equally available for all seedlings. At the end of the summer the seedlings were sprayed with acid water. The pH values used were 5.5, 4.5, 4.0, 3.5 and 3.0. Net carbon consumption in field conditions during and after the spraying period was measured. A regression model explaining the light response of carbon consumption was calculated based on the gas exchange data measured before the spraying period. The net carbon consumption during the spraying period was compared with the consumption predicted by the model. The net carbon consumption of the control seedling followed the predicted one during the whole period of spraying. The seedlings suffering from severe potassium deficit showed clear decrease of carbon consumption at pH 4.0 and lower. The effect seemed to last several days. The seedling suffering from light potassium deficit did not show a clear decrease of carbon consumption above pH 3.0 and the effect lasted only a few days. (Author's abstract)
W88-10561

PRELIMINARY OBSERVATIONS ON THE EFFECTS OF ACID RAIN ON THE ULTRASTRUCTURE OF PINE NEEDLES (ALUSTAVIA HAVAINTOJA HAPPAMAN SATEEN VAIKUTUKSISTA MANNYN NEULASTEN HIENORAKENTEESEEN),
Oulu Univ. (Finland).
J. Reinikainen, and S. Huttunen.
Aquilo, Ser. Botanica ASBOD8, Vol. 25, No. 2, p 147-152, 1987. 6 fig., 17 ref.

Descriptors: *Water pollution effects, *Pine trees, *Acid rain, *Plant pathology, *Plant morphology, Acidic water, Simulated rainfall, Electron microscopy, Conifers.

Artificially exposed Pinus sylvestris needles, which had been showered with acidic water (pH 3 and 4), were studied. On a light microscopical level no differences between the exposed and the control needles could be observed. The mesophyll of the needles was then examined with a transmission electron microscope. Primarily, the alterations appeared in the cytoplasm, which became heavily vesiculated. Some small vacuoles included remnants of cytoplasmic organelles or lipid-like material, which also was accumulating into the cytoplasm. The chloroplasts appeared rounded and had swelling thylakoids, probably due to water stress. These alterations may be indicative of increased lysosomatic activity in the cytoplasm and disturbances in the synthesis of membranes. No effect of disturbed wintering was observable, probably because of the short duration of the exposure. (Author's abstract)
W88-10562

LITTORAL SAND ZOOBENTHOS AND ITS RELATION TO ORGANIC POLLUTION IN LAKE NEMI (CENTRAL ITALY),
Rome Univ. (Italy). Dept. of Animal and Human Biology.
L. Mastrantuono.
Hydrobiological Bulletin HYBUD9, Vol. 19, No. 2, p 171-178, December 1986. 3 fig, 3 tab, 23 ref.

Descriptors: *Lakes, *Italy, *Water pollution effects, *Littoral environment, *Benthic fauna, *Organic load, *Water quality, *Macroinvertebrates, Species composition, Population dynamics, Aquatic habitats, Aquatic animals, Pollution load, Bioindicators, Lake Nemi, Sand.

The results of a study on the littoral sand zoobenthos in the polluted Lake Nemi are reported and the role of this community in the evaluation of water quality in lakes is discussed. The fauna was composed of 65 taxa belonging to 15 zoological groups. Oligochaeta were dominant, followed by Diptera (Chironomidae), Crustacea and Nematoda. Oligochaeta, including 21 taxa, had the maximum percentage occurrence in the discharge zones, with

prevalence of species very tolerant to organic enrichment. On the contrary, Chironomidae showed a depletion in the same zones, where we also observed the absence of Tanytarsini, typical of oligo-mesotrophic conditions, and the exclusive presence of Diptera (Psychodidae), considered as indicators of pollution. The community structure is related to the pollution status at the sampling points, in a similar way as can be observed in profundal macrobenthos. (Author's abstract)
W88-10577

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): III. IMPACT OF MAN ON THE MATTER INPUT AND SEDIMENTATION IN THE PAST,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
K. Stasiak, and A. Tatur.
Ekologia Polska ELPLBS, Vol. 33, No. 2, p 225-232, 1985. 2 fig, 12 ref.

Descriptors: *Lakes, *Eutrophication, *Poland, *Limnology, *Jorka River, *Rivers, *Paleolimnology, Watersheds, Deforestation, Lake sediments, Fish farming, Wastewater disposal.

Results obtained during palynological and chemical investigations of cores of bottom sediments of five Masurian lakes is presented. On the basis of determined pollen stratigraphy, the content of chlorophyll and silicates, the history of lake productivity is discussed against the landscape evolution and as a result of varying economic activities of man in the watershed. Accepting the concentration of sedimentary chlorophyll derivatives as a measure of variations in productivity, Two major periods of productivity in five Masurian lakes were distinguished: at the beginning of lake history, and at a recent period in lake history, which is visible at the top of the cores. This period was somewhat delayed by widespread deforestation. In the recent history of the lakes the rapidly increasing productivity is frequently due to the increasing amount of easily available nutrients, reaching the water as a result of inorganic fertilization, sewage release, and rainbow trout farming. The range of changes is not only caused by the activities of man; the lake fertility in the past as well as its natural susceptibility to eutrophication has some significance. (See also W88-10590) (Author's abstract)
W88-10592

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VI. NUTRIENT INPUT WITH WATER TRANSPORT,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W88-10595

FACTORS AFFECTING NUTRIENT BUDGET IN LAKES OF THE R. JORKA WATERSHED (MASURIAN LAKELAND, POLAND): VII. INPUT AND REMOVAL OF NUTRIENTS WITH FISH,
Lodz Univ. (Poland). Inst. of Environmental Biology.
For primary bibliographic entry see Field 5B.
W88-10596

PHYTOSESTON OF THE VISTULA RIVER BETWEEN GORA KALWARIA AND NOWY DWOR MAZOWIECKI IN 1982,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
A. T. Simm.
Ekologia Polska ELPLBS, Vol. 33, No. 3, p 439-453, 1985. 5 fig, 2 tab, 15 ref.

Descriptors: *Vistula Rivers, *Water pollution, *Poland, *Eutrophication, *Rivers, *Seston, Algae, Diatoms, Chlorophyta, Biomass, Cyclotella, Stephanodiscus.

Between May and the beginning of October 1982, samples of the Vistula phytoseston were taken 2-4 times a month at Gora Kalwaria in Warsaw and at Nowy Dwor mazowiecki. In the spring and autumn of 1982 diatoms, mainly Stephanodiscus hantzchii Grun. (100-130 million cells/cu dm, to 50 mg wet wt./cu dm).predominated in the Vistula. Green algae predominated quantitatively in the summer (Chlorococcales, up to 70 million cells/cu dm, 2-5 mg wet wt./cu dm), but their biomass was lower than that of diatoms of the genus Cyclotella (mainly C. meneghiniana Kutz, up to 20 million cells/cu dm, 6-15 mg wet wt/cu dm). In the summer the phytoseston biomass increased evenly down-stream of the river reach examined. The Vistula is a strongly polluted river, with a very high phytoseston concentration and a very strong dominance of several species determining the biomass of phytoseston. Rapid development of algae in the Vistula is at present a serious danger when using its waters for industrial and economic purposes. (Author's abstract)
W88-10604

EFFECT OF INDUSTRIAL POLLUTION ON LAKE EWINGI (MASURIAN LAKELAND) ESTIMATED BY REMOTE SENSING TECHNIQUES,
Instytut Ksztaltowania Srodowiska, Warsaw (Poland).
For primary bibliographic entry see Field 5A.
W88-10611

ABUNDANCE, DISTRIBUTION AND LIFE CYCLES OF MIDGES (CHIRONOMIDAE: DIPTERA) IN AN ACID STRIP-MINE LAKE IN SOUTHERN ILLINOIS,
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-10635

STUDY OF SOME PHYSIOCHEMICAL PROPERTIES OF NILWALA RIVER WATERS IN SOUTHERN SRI LANKA WITH SPECIAL REFERENCE TO EFFLUENTS RESULTING FROM ANTHROPOGENIC ACTIVITIES,
Ruhuna Univ., Matara (Sri Lanka). Dept. of Botany.
For primary bibliographic entry see Field 4C.
W88-10641

PERIPHYTON COMMUNITIES IN A PRISTINE MOUNTAIN STREAM ABOVE AND BELOW HEAVY METAL MINING OPERATIONS,
Victoria Univ. (British Columbia). Dept. of Biology.
J. Deniseger, A. Austin, and W. P. Lucey.
Freshwater Biology FWBLAB, Vol. 16, No. 2, p 209-218, April 1986. 3 fig, 2 tab, 35 ref.

Descriptors: *Streams, *Periphyton, *Heavy metals, *Mine wastes, *Oligotrophic lakes, *Water pollution effects, Diatoms, Chlorophyta, Species diversity, Ecology, Species composition, Water sampling, Myra Creek, Substrates, Population density, Seasonal variatins.

Changes in species composition of the periphyton on introduced substrates were determined in an oligotrophic mountain stream (Myra Creek, Vancouver Island, British Columbia) subject to long-term heavy metal contamination. At the upstream control site, the numerically most abundant taxa were Bacillariophyta, as well as in summer, the Chlorophyta. At the downstream contaminated site the periphyton community was totally dominated by Bacillariophyta throughout the sampling period. Achnanthes minutissima and Achnanthes microcephala were co-dominants during spring. Seasonal succession patterns did not parallel those at the upstream site. Chlorophyta were virtually absent and A. minutissima comprised 94% of the community during summer. Species diversity, species evenness and dissimilarity index were utilized to detect differences in species composition, abundance and number. Slight differences were found in spring samples while summer samples indicated major differences between sampling sites. (Author's abstract)
W88-10654

PHYTOPLANKTON OF AN ENRICHED, SOFT-WATER LAKE SUBJECT TO INTERMITTENT HYDRAULIC FLUSHING (GRASMERE, ENGLISH LAKE DISTRICT),
Freshwater Biological Association, Windermere (England).
C. S. Reynolds, and J. W. G. Lund.
Freshwater Biology FWBLAB, Vol. 19, No. 3, p 379-404, June 1988. 18 fig, 1 tab, 33 ref, append.

Descriptors: *Water pollution effects, *Limnology, *Eutrophication, *Grasmere, *Flushing, *Phytoplankton, *Lakes, Mesotrophic lakes, Hydraulics, Biomass, Chlorophyll, Phosphorus, Regression analysis, Nutrients, Rainfall, Catchment areas, England.

The abundance and species composition of the phytoplankton of Grasmere were monitored over a 12-year period following the commissioning of a small sewage treatment works, upstream of the lake. Mean biomass levels (as indicated by chlorophyll concentration) have increased in response to the enrichment, though they do not conform well with most chlorophyll/phosphorus regression-models. The key factor resisting a more complete transition to a typical eutrophic plankton appears to be the efficiency of episodic flushing of the lake during periods of high fluvial discharge sustained by heavy rainfall over the extensive, mountainous catchment. The probabilities that these limnological conditions might fail to deter the development of 'nuisance' blooms are briefly assessed. (Author's abstract)
W88-10672

MACROINVERTEBRATE FAUNA OF AN ACID-STRESSED HEADWATER STREAM SYSTEM IN THE ADIRONDACK MOUNTAINS, NEW YORK,
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
K. W. Simpson, R. W. Bode, and J. R. Colquhoun.
Freshwater Biology FWBLAB, Vol. 15, No. 6, p 671-681, December 1985. 4 fig, 2 tab, 39 ref, append.

Descriptors: *New York, *Hydrogen ion concentrations, *Aquatic insects, *Water pollution effects, *Acid rain, *Acidic water, *Stream biota, *Aquatic animals, *Macroinvertebrates, Streams, Adirondack Mountains, Rainfall, Precipitation, Ephemerella, Oulimnius, Simulium, Leuctra Isoperla, Ecological effects, Pollutants, Rhyacophila, Headwaters.

The Silver Run system in the Adirondack Mountains of New York includes 3 first-order streams with very different pH regimes: one moderately acidic (pH 5.8-7.2), the others much more so (pH generally 4.4-5.0). The less acidic (acidophilic) site yielded a relatively diverse, well-balanced fauna, with 10% each of midges, mayflies, stoneflies and elmid beetles. Ephemerella funeralis (Ephemeroptera) and Oulimnius latiusculus (Coleoptera) were dominant in this community. They appear to be among the most acid-tolerant species of their respective families and may become abundant under moderately acidic conditions. Their absence or low abundance in the more acidic tributuaries of the Silver Run systems suggests that they are eliminated as acidification intensifies. These species therefore may be useful indicators of advancing acidification. The more acidic (acidobiontic) communities contained fewer than half as many taxa as the acidophilic communities, contained few elmid beetles or mayflies, and were heavily dominated by stoneflies. Leuctra ferruginea and Isoperla sp. were dominant, comprising 56-86% of the individuals. Other common constituents included black flies (Simulium gouldingi and Simulium venustum) and the caddisfly Rhyacophila fuscula. (Author's abstract)
W88-10693

DISTRIBUTION OF BREEDING DIPPERS (CINCLUS (L.); AVES) IN RELATION TO STREAM ACIDITY IN UPLAND WALES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
S. J. Ormerod, N. Allinson, D. Hudson, and S. J. Tyler.
Freshwater Biology FWBLAB, Vol. 16, No. 4, p 501-507, August 1986. 2 fig, 2 tab, 35 ref.

Descriptors: *Dippers, *Water birds, *Acid streams, *Water chemistry, *Population dynamics, Reproduction, Limiting nutrients, Streams, Wales, Predation, Hydrogen ion concentration, Alluminum, Aquatic insects, Acidic water, Food habits, Food chains.

The distribution of breeding dippers was assessed in 1984 over seventy-four sites on soft-water streams throughout mid and north Wales. Sites without breeding dippers had significantly higher mean concentrations of filterable aluminum, lower mean pH, fewer trichopteran larvae and ephemeropteran nymphs, and were on rivers with more conifer afforestation on their catchments, than sites where dippers were present. It is speculated that influences that increase the acidity of soft-water streams could be detrimental to populations of dippers, although further data are required on causative mechanisms. (Author's abstract)
W88-10706

SHORT-TERM EXPERIMENTAL ACIDIFICATION OF A WELSH STREAM: COMPARING THE BIOLOGICAL EFFECTS OF HYDROGEN IONS AND ALUMINIUM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
S. J. Ormerod, P. Boole, C. P. McCahon, N. S. Weatherley, and D. Pascoe.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 341-356, April 1987. 7 fig, 8 tab, 50 ref, append.

Descriptors: *Aluminum, *Hydrogen ion concentration, *Water pollution effects, *Acid rain, *Toxicity, Macroinvertebrates, Spatial distribution, Acid streams, Water chemistry, Heavy metals,Aquatic habitats, Aquatic animals, Population dynamics, Fish, Streams, Wales, Cadmium, Mortality.

A soft-water stream in upland Wales was dosed with sulfuric acid and aluminum sulfate at two successive points to create simultaneous episodes of low pH, and low pH with increased aluminum. Chemical and biological responses were measured before, during and after the episode and were compared with a reference zone. The pH fell from 7.0 to 4.28 and 5.02 respectively in the acid and aluminum zones. Corresponding aluminum concentrations during the episode were 0.052 g Al/cu m and 0.347 g Al/cu m, the former not differing significantly from the reference zone. The concentration of cadmium rose to 0.002-0.011 g Cd/cu m in both treated areas, but the concentrations of other metals were unchanged. In situ toxicity tests were performed with macroinvertebrates and fish. Chironomus riparius, Hydropsyche angustipennis and Dinocras cephalotes suffered no mortality. Ecdyonurus venosus, Baetis rhodani, and Gammarus pulex showed up to 24% mortality in both treatment zones and further mortalities occurred after the episode. Brown trout Salmo trutta and salmon (Salmo salar) showed 7-10% mortality in the acid zone, but 50-87% in the aluminum zone, where salmon had a significantly shorter LT50 than trout. The drift of Simuliidae increased during treatment in both acid and aluminum zones. The most pronounced response was by Baetis rhodani in the aluminum zone where drift density increased by 8.4x during the episode. Baetis rhodani was the only taxon to show a significant decline in benthic density during the treatment, and then only in the aluminum zone. Drift could account for most of the losses. The depth distribution of invertebrates in the substratum differed between zones following treatment. More individuals were present at the surface of the reference zone than at the surface of the other zones, however, densities at greater depths were similar. These patterns probably reflected differences prior to the treatments. (Author's abstract)
W88-10736

EFFECTS OF COMBINATIONS OF HEAVY METALS, HYPOXIA AND SALINITY ON OXYGEN CONSUMPTION AND CARBOHYDRATE METABOLISM IN CRANGON CRANGON (L.) AND CARCINUS MAENAS (L.),
Copenhagen Univ. (Denmark). Marine Biological Lab.
I. Johnson.
Ophelia OPHLAN, Vol. 27, No. 3, p 155-169, July 1987. 7 fig, 4 tab, 33 ref.

Descriptors: *Water pollution effects, *Oxygen requirements, *Carbohydrates, *Metabolism, *Marine animals, *Crustaceans, *Hypoxia, *Salinity, *Heavy metals, Dissolved oxygen, Aquatic habitats, Population exposure, Sublethal effects, Dissolved oxygen, Toxicity, Copper, Zinc, Carcinus, Crabs, Crangon.

The effects of sublethal Cu and Zn levels on the oxygen consumption and carbohydrate metabolism of Crangon crangon and Carcinus maenas have been investigated, in combination with the environmental factors of salinity and oxygen saturation. In normoxia MO2 (weight-specific oxygen consumption) and blood glucose and lactate levels were not affected by exposure to 0.25 mg/L Cu or Zn in either species. However, in both species combination of heavy metals and hypoxia resulted in large decreases in MO2 and concomitant increases in blood glucose and lactate at two salinities (13.5 and 27.0o/oo). In certain instances these interactions between Cu or Zn and hypoxia were synergistic in nature. The results are discussed with respect to the modifying influences of environmental factors on the physiological responses of decapods to heavy metal exposure. (Author's abstract)
W88-10759

POPULATION DYNAMICS OF MACOMA BALTHICA IN THE DANISH WADDEN SEA IN AN ORGANICALLY ENRICHED AREA,
P. B. Madsen, and K. Jensen.
Ophelia OPHLAN, Vol. 27, No. 3, p 197-208, July 1987. 7 fig, 4 tab, 39 ref.

Descriptors: *Water pollution effects, *Coastal waters, *Mollusks, *Enrichment, *Organic wastes, *Macoma, *Population dynamics, Spatial distribution, Seasonal variation, Aquatic animals, Aquatic habitats, Wadden Sea, Wastewater, Biomass, Productivity, Food habits, Reproduction, Denmark.

The population dynamics of Macoma balthica have been studied at two localities in the Danish Wadden Sea suffering from organic enrichment due to waste-water discharge. The study demonstrated increased abundance and biomass, and also increased shell growth, production, production/biomass ratio and condition index in the organically enriched area presumably due to the increased food supply. All settled spat were observed to disappear at the locality closest to the waste-water sources. The study could not demonstrate any effect on adult mortality, gonadal development, or vertical distribution of the specimens. (Author's abstract)
W88-10760

EXTREME METAL AND ACID TOLERANCE OF EUGLENA MUTABILIS AND AN ASSOCIATED YEAST FROM SMOKING HILLS, NORTHWEST TERRITORIES, AND THEIR APPARENT MUTUALISM,
Toronto Univ. (Ontario). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W88-10772

BOUNDS AND POTENTIAL EFFECTS OF NH4(+) (LOADING) ON THE PELAGIC SYSTEM OF A BALTIC ESTUARY,
Rostock Univ. (German D.R.). Dept. of Biology.
U. Schiewer, H. Arndt, G. Baader, G. Ballin, and R. Borner.
Limnologica LMNOA8, Vol. 17, No. 1, p 7-28, April 1986. 14 fig, 5 tab, 44 ref.

Descriptors: *Estuaries, *Ammonium, *Water pollution effects, *Ammonium, *Eutrophication, Biological properties, Biomass, Toxicity, Phytoplankton, Chemical properties, Baltic Sea, Limiting nutrients, Nitrogen compounds, Cyanophyta, Chlorophyta, Algae, Zooplankton, Succession.

Complex experimental studies regarding effects of different NH4(+) loadings were performed on enclosed samples of the Zingster Strom, a highly eutrophic estuary of the Baltic Sea. The load capacity of the pelagic enclosures is not exceeded in summer by the addition of 50 micromol/L HN4(+). In contrast, the addition of 270 micromol/L NH4(+) induces obvious disturbances in the system: toxic effect on the zooplankton and temporal reduction of the rate of bacterial activity. Under P-limiting conditions, surplus NH4(+) is stored in algal cells and is liberated rhythmically. This NH4(+) rhythm is restricted mainly to the blue-green algae. During the eight days of investigation, the most striking changes took place in the structures of phytoplankton and zooplankton. The relative slight variation in the bacterial counts and biomasses is remarkable. The tendency to stabilize productivity was typical of phytoplankton and zooplankton. Bacterial activity was characterized by distinct and sometimes very rapid fluctuation. The principal factor that governed the development of the phytoplankton succession was the temperature. Loading with N and P simultaneously permitted the development of green algae. (Author's abstract)
W88-10798

INPUT OF DECOMPOSABLE ORGANIC MATTER AND BIOMASS CONCENTRATION IN THE PLANKTON OF RESERVOIRS,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 5B.
W88-10816

PHYTOPLANKTON OF THE ZELIVKA RESERVOIR (CZECHOSLOVAKIA),
Vyzkumnmy Ustav Rybarsky Vodnany (Czechoslovakia).
V. Houk.
Limnologica LMNOA8, Vol. 17, No. 2, p 291-300, October 1986. 6 fig, 6 tab, 12 ref.

Descriptors: *Phytoplankton, *Biomass, *Productivity, *Cycling nutrients, *Water pollution effects, *Reservoirs, *Organic compounds, Seasonal variations, Phosphorus, Chlorophyll, Vegetation, Diatoms, Reservoir releases, Czechoslovakia.

The results of a several-year investigation of the abundance and biomass of phytoplankton (PB), total phosphorus (TP), chlorophyll-a (CHA) and reactive orthosilicate (RO), near the dam of the Zelivka Water Supply Reservoir, are presented. The following averages for the vegetation period were found: Avg. PB (1977-1984) 17.1 to 38.4 g/sq m, avg. CHA (1980-1984) 2.40 to 4.20 mg/cu m, avg. TP (1978-1984) 13.4 to 16.5 mg/sq m, avg. RO (1978-1981) 2.98 to 4.81 mg/l SiO2. Avg. PB and TP show a tendency to gradually decrease. Diatoms, essentially Asterionella formosa, Cyclotella comta, Fragilaria crotonensis, and Melosira italica, represented almost 2/3 of the phytoplankton biomass, followed by cryptomonads. With the exception of the year 1983 and 1984, a highly significant negative linear dependence of avg. TP on reservoir releases in the preceding November to April was found. Positive linear dependence of avg. CHA on the reservoir inflow in preceding November to April and negative linear dependencies of avg. TP on reservoir flushing were also found. (Author's abstract)
W88-10817

RELATION OF THE ZOOPLANKTON BIOMASS AND SHARE OF LARGE CLADOCERANS TO THE CONCENTRATION OF TOTAL PHOSPHORUS, CHOROPHYLL-A AND TRANSPARENCY IN HUBNEOV AND VRCHLICE RESERVOIRS,
Ceskoslovenska Akademie Ved, Prague.

J. Hrbacek, O. Albertova, B. Desortova, V. Gottwaldova, and J. Popovsky.
Limnologica LMNOA8, Vol. 17, No. 2, p 301-308, October 1986. 4 fig, 2 tab, 14 ref.

Descriptors: *Zooplankton, *Biomass, *Reservoirs, *Phosphorus, *Water pollution effects, *Transparency, *Cycling nutrients, Productivity, Ecosystems, Fish populations, Chlorophyll, Phytoplankton.

The biomass of zooplankton as measured by buiret nitrogen in two Czechoslovakia reservoirs did not correlate with total phosphorus. The percentage of the cladocerans retained on sieve with 0.71 mm apertures in total zooplankton and in cladoceran biomass was used as a measure of the impact of fish predation on zooplankton. The cladoceran biomass correlated positively with transparency and negatively with chlorophyll-a concentrations. It is suggested that transparency may be used as a measure of long-term changes in the fishstock when changes in the phosphorus load are low. (Friedmann-PTT)
W88-10818

EFFECTS OF WATER ACIDITY ON SWIMBLADDER FUNCTION AND SWIMMING IN THE FATHEAD MINNOW, PIMEPHALES PROMELAS,
Manitoba Univ., Winnipeg. Dept. of Zoology.
W. A. Jansen, and J. H. Gee.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 1, p 65-77, January 1988. 3 fig, 7 tab, 85 ref.

Descriptors: *Acid rain, *Acidity, *Fathead minnows, *Fish physiology, *Water pollution effects, Population exposure, Fish populations, Minnows, Hydrogen ion concentration, Acid water, Animal physiology, Aquatic animals, Carbon dioxide, Fish behavior, Swimming, Pimephales.

Swimbladder function, buoyancy-related behavior, and swimming performance were examined in fathead minnows (Pimephales promelas) following chronic (>4 d) exposure to acid-treated water (pH 5.3). When denied surface access in still water, treated fish, unlike controls (pH 7.7), failed to increase buoyancy and standard volume over 'access to air' levels and had significantly higher proportions of swimbladder CO2 and O2. In current, treated fish reduced buoyancy over 48 H to a lesser extent than controls and were severely limited in their ability to increase internal pressure of swimbladder gases. The pH significantly affected the maintenance of a minimum buoyancy over 32 d. upon transfer from current to still water without access to air, the rate of buoyancy adjustment over 48 h was significantly slower in treated fish. With surface access, fish of both groups filled swimbladders within 6-12 h following removal from current; however, treated fish displayed significantly lower proportions of swimbladder CO2 and O2 at 12 and 24 h. Both groups of fish compensated hydrodynamically for insufficient static lift with higher frequencies of pectoral fin beats, treated fish having generally higher frequencies. Swimming performance was unaffected by water pH, but treated fish lost more weight than controls. The authors propose that swimbladder function contributes to the elimination of fathead minnows from acidified environments. (Author's abstract)
W88-10822

EFFECTS OF ACID PH SHOCK ON PHOSPHATE CONCENTRATIONS AND MICROBIAL PHOSPHATE UPTAKE IN AN ACIDIFYING AND A CIRCUMNEUTRAL LAKE,
Toronto Univ. (Ontario). Div. of Life Sciences.
C. Nalewajko, and M. A. O'Mahony.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 254-260, February 1988. 5 fig, 2 tab, 29 ref. Associate Committee on Scientific Criteria for Environmental Quality Grant No. OSU82-00267.

Descriptors: *Acidity, *Microbial studies, *Acid rain, *Hydrogen ion concentration, *Lakes, *Phosphates, *Water pollution effects, Acidic water, Aquatic environment, Acid shock, Ontario, Toxicity, Absorption, Chemical properties.

Water samples from Plastic Lake and St. Nora Lake, Dorset, Ontario, were subjected to a rapid decrease in pH (acid pH shock). In both lakes, phosphate concentrations changed following pH shock. Minimal phosphate concentrations were observed in the pH 5.2-5.8 range. Maximal concentrations in both lakes occurred at pH 4.0: in Plastic Lake the mean increase at pH 4 wa 3.0 times ambient and in St. Nora Lake was 2.5 times ambient. Particles > 0.45 microns were the major source of the phosphate released on acid pH shock. Rate constants of 32PO4 uptake by microorganisms decreased in response to acid pH shock, and bacteria were affected more than algae; the decrease in rate constants was more severe in Plastic than in St. Nora Lake but the authors could not distinguish the relative contributions of H+ toxicity and isotope dilution (by the extra phosphate released) to the observed decline. (Author's abstract)
W88-10831

INFLUENCE OF PH ON THE ACUTE LETHALITY OF FENITROTHION, 2,4-D, AND AMINOCARB AND SOME PH-ALTERED SUBLETHAL EFFECTS OF AMINOCARB ON RAINBOW TROUT (SALMO GAIRDNERI),
Environmental Protection Service, Dartmouth (Nova Scotia).
K. G. Doe, W. R. Ernst, W. R. Parker, G. R. J. Julien, and P. A. Hennigar.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 2, p 287-293, February 1988. 3 fig, 3 tab, 33 ref.

Descriptors: *Rainbow trout, *Toxicity, *Pesticides, *Hydrogen ion concentration, *Water pollution effects, Population exposure, Sublethal effects, Mortality, Biochemistry, Lethal limit, Organic pesticides.

Three pesticides, fenitrothion, 2-4-D, and aminocarb, were tested in static 96-h acute lethal toxicity tests using fingerling rainbow trout (Salmo gairdneri) at pH 4.6, 5.6, 6.9, and 8.5. The toxicity of aminocarb, a base, increased significantly with increasing pH. Conversely, the toxicity of the acidic pesticide 2,4-D increased with decreasing pH. The toxicity of the neutral pesticide fenitrothion did not change significantly with changing pH. Subsequent tests were performed on trout fingerlings with aminocarb to determine the effect of two exposure pH's on brain acetylcholinesterase activity and whole-body aminocarb residue. Brain acetylcholinesterase was found to be inversely proportional to whole-body aminocarb content of fish. In fish exposed at pH 4.6, brain acetylcholinesterase was maximally depressed at 6 h, after which it recovered to within the control range. Whole-body aminocarb concentrations rose to a maximum within 6 h and subsequently declined to low levels. In fish exposed at pH 8.2, brain acetylcholinesterase dropped below the control range by 1 h and remained low until all fish died by 72 h. A maximum whole-body aminocarb concentration was reached within 1 h and remained elevated until the fish died. Several explanations for the observed results are presented. (Author's abstract)
W88-10833

INCREASE IN CLIONA DELITRIX INFESTATION OF MONTASTREA CAVERNOSA HEADS ON AN ORGANICALLY POLLUTED PORTION OF THE GRAND CAYMAN FRINGING REEF,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
C. S. Rose, and M. J. Risk.
PSZNI: Marine Ecology, Vol. 6, No. 4, p 345-363, 1985. 7 fig, 3 tab, 37 ref.

Descriptors: *Bioerosion, *Wastewater pollution, *Reefs, *Water pollution effects, *Biomass, *Sewage bacteria, Corals, Feces, Silt, Cayman Islands, Coastal waters.

A marked increase in the biomass of Cliona delitrix infesting Montastrea cavernosa substrate occurred in a portion of the Grand Cayman fringing reef affected by the discharge of untreated fecal sewage. It is suggested that the six-fold increase in bacteria biomass (both 'coliforms' and natural marine bacterioplankton) in reef waters receiving the sewage effluent is linked to a five-fold increase in sponge biomass at the polluted site relative to a control site. The elevated density of C. delitrix biomass signifies a similar increase in the amount of M. cavernosa skeleton that has been eroded by this sponge and reduced to silt-sized sediment. Thus, the proliferation of a bioeroding organism in the sewage-stressed environment has caused a shift in the carbonate balance on the reef. (Author's abstract)
W88-10853

INFLUENCE OF DISTILLERY EFFLUENT ON GROWTH AND METAMORPHOSIS OF RANA MALABARICA (BIBRON),
Saint Xavier's Coll., Palyamkottai (India). Dept. of Zoology.
M. A. Haniffa, S. T. De Souza, A. G. Murugesan, and B. Xavier.
Proceedings of the Indian Academy of Sciences (Animal Science), Vol 94, No. 2, p 111-116, April 1985. 1 fig, 3 tab, 15 ref.

Descriptors: *Teratogenesis, *Industrial wastes, *Water pollution effects, Population exposure, Animal physiology, Amphibians, Morbidity, Animal populations.

This investigation is a preliminary report dealing with the effect of distillery effluent on growth and metamorphosis of the amphibian Rana malabarica. Increase in effluent concentration reduced the period of limb bud emergence and tail resorption; it also produced elevated values for length of limbs, tail and body weight of adult R. malabarica. Analysis of variance (Anova test) confirmed that time (week) has a more pronounced effect on morphological parameters ($P < 0.05$) than treatment ($P > 0.05$). (Friedmann-PTT)
W88-10855

EFFECT OF ZINC ON ZOEAL DEVELOPMENT OF THE ESTUARINE HERMIT CRAB CLIBANARIUS OLIVACEUS (HENDERSON),
Annamalai Univ., Annamalainagar (India). Centre of Advanced Study in Marine Biology.
S. Ajmalkhan, K. Rajendran, and R. Natarajan.
Proceedings of the Indian Academy of Sciences (Animal Science), Vol 95, No. 5, p 515-524, October 1986. 3 fig, 6 tab, 14 ref.

Descriptors: *Zinc, *Water pollution effects, *Crabs, *Mortality, Animal populations, Sublethal effects, Larvae, Survival, Heavy metals, Reproduction, Development, Toxicity, Population exposure.

The 96 h LC sub 50 value for zinc was 100 ppb. Larvae reared in 7 sublethal (1, 5, 10, 30, 50, 70, 90 ppb) and 96 h LC sub 50 level concentrations (100 ppb) showed survival rates more than 10%, thus perfectly fitting in with definition of chronic concentrations. Survival rate of larvae decreased with increase in test concentration, but in the different chronic test concentrations, the overall time required for the completion of zoeal development did not differ significantly from that of control. (Author's abstract)
W88-10856

LIMNOLOGY OF RIVER COOUM WITH SPECIAL REFERENCE TO SEWAGE AND HEAVY METAL POLLUTION,
Presidency Coll., Madras (India). Dept. of Zoology.
B. Anantharaj, V. Bagyalakshmi, and R. Lakshmi.
Proceedings of the Indian Academy of Sciences (Animal Science), Vol. 96, No. 2, p 141-149, March 1987. 5 fig, 26 ref.

Descriptors: *River Cooum, *Wastewater pollution, *Water pollution effects, *Lotic environment, *Eutrophication, *Heavy metals, Water pollution, India, Biomass, Sewage, Zooplankton, Iron, Nickel, Lead, Zinc.

The physical, chemical, and biological variables and pollution of River Cooum with sewage and heavy metals were studied in four stations within Madras City (India) from August 1982 to July 1983. The physical, chemical and biological parameters presented a complex pattern of variations indicating that the biotic life of the river Cooum is severely affected by the discharge of sewage effluents within the city limits that excessively eutrophicate the river water. The number of species and density of zooplankton are very low. Heavy metals such as iron, nickel, lead and zinc were recorded at above permissible levels. (Author's abstract)
W88-10858

CADMIUM-INDUCED VERTEBRAL DEFORMITIES IN AN ESTUARINE FISH, AMBASSIS COMMERSONI CUVIER,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
V. Pragatheeswaran, B. Loganathan, R. Natarajan, and V. K. Venugopalan.
Proceedings of the Indian Academy of Sciences (Animal Science), Vol. 96, No. 4, p 389-393, July 1987. 2 fig, 23 ref.

Descriptors: *Cadmium, *Bone development, *Water pollution effects, *Toxicity, Population exposure, Morbidity, Heavy metals, Minerals, Magnesium, Animal physiology, Metabolism, Calcium, Phosphorus.

Ambassis commersoni was treated with three different concentrations (0.1, 0.25, and 0.5 ppm) of cadmium up to 120 days. Fishes treated in higher concentrations developed vertebral deformity and the deformation was prominent after the 89th and 115th day. The levels of the vertebral minerals such as calcium, magnesium and phosphorus decreased at all exposure concentrations and minerals lost were directly proportional to the toxic concentrations. Nearly 2/3 of skeletal mineral composition was eliminated in the deformed fish. Vertebral fracture was attributed mainly to the large amount of vertebral components eliminated from the vertebrae. Vertebral cadmium accumulation was also linear in relation to the experimental concentration. (Author's abstract)
W88-10859

POLLUTION OF THE SEAS AROUND INDIA,
Department of Ocean Development, New Delhi (India).
S. Z. Qasim, R. S. Gupta, and T. W. Kureishy.
Proceedings of the Indian Academy of Sciences (Animal Science), Vol. 97, No. 2, p 117-131, March 1988. 3 fig, 7 tab, 33 ref.

Descriptors: *Indian Ocean, *Water pollution, *Pesticides, *Oil, *Estuaries, *Coastal environments, India, Marine environments, Population exposure, Public health, Pesticides, Zooplankton, Sediments, India, Toxicity, Urban runoff, Sewage, Heavy metals, Environmental protection, Water quality control, Hydrogen sulfide, Chlorinated hydrocarbons, Oxygen depletion, Estuaries.

The state of marine pollution along the 7000 km-long coastline and 2.015x 10 to the 6th power sq km exclusive economic zone of India is summarized. The coastal water receives 4.1 cu km of domestic sewage and 0.41 cu km of industrial wastes. Nearly 447 million tons of oil and its products are transported through the Arabian Sea and Bay of Bengal with the result that some of India's coastal areas, particularly those adjoining the large cities, are getting polluted. Increased eutrophication and decrease in dissolved oxygen associated with the generation of toxic hydrogen sulfide have been observed at several places. Heavy metal concentrations are largely within the acceptable limits in water and in biota except for a few areas. Organochlorine and pesticide residues have often been found to be high in zooplankton and in the sediments near the confluence of the river and the sea, indicating their land origin. Oil pollution is a chronic problem in the northern Indian Ocean. Several of the endangered ecosystems have now been offered protection by declaring them as marine parks. It is recommended that to maintain clean coastal waters, wise and judicious use of the ocean must form an integral part of India's planning. (Author's abstract)
W88-10860

EFFECT OF COPPER, CADMIUM AND ZINC ON FISH-FOOD ORGANISMS, DAPHNIA LUMHOLTZI AND CYPRIS SUBGLOBOSA,
Andhra Pradesh Agricultural Univ., Hyderabad (India). Dept. of Fishery Science.
H. K. Vardia, P. S. Rao, and V. S. Durve.
Proceedings of the Indian Academy of Sciences (Animal Science), Vol. 97, No. 2, p 175-180, March 1988. 1 fig, 2 tab, 12 ref.

Descriptors: *Water pollution effects, *Toxicity, *Bioassay, *Daphnia, *Fish food organisms, *Heavy metals, Sublethal effects, Sensitivity, Zinc, Cadmium, Water pollution, Copper, Ostracods, Fisheries, Population exposure.

The results of static and acute bioassay studies on Daphnia lumholtzi (Cladocera) and Cypris subglobosa (Ostracoda) to the varying dosages of Cu, Cd and Zn are presented. The 96 h, LC sub 50 values for Daphnia were 0.009, 0.083, and 0.437 and for Cypris 0.25, 0.687 , 8.3 /mgl for Cu, Cd and Zn, respectively. This indicates that Daphnia is very sensitive while Cypris has a good amount of resistance. The rank order for toxicity of three metals is Cu > Cd > Zn. The study indicates that the waters getting polluted by heavy metals even at low concentration would remove the population of fish-food organisms without directly affecting fish fauna, thus making water body unfit for fishery use. (Author's abstract)
W88-10861

PROFUNDAL MACROBENTHOS IN A POLLUTED LAKE: DEPTH DISTRIBUTION AND ITS RELATIONSHIP WITH BIOLOGICAL INDICES FOR WATER QUALITY ASSESSMENT,
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
M. Bazzanti, and M. Seminara.
Acta Oecologia, Oecologia Applicata AOSADN, Vol. 8, No. 1, p 15-26, 1987. 5 fig, 2 tab, 48 ref.

Descriptors: *Bioindicators, *Limnology, *Macroinvertebrates, *Lakes, *Eutrophication, *Water pollution effects, Water quality, Monitoring, Oligochaetes, Nematodes, Diptera, Depth distribution, Organic matter, Lake Nemi, Italy.

A study on the profundal macrobenthos of a polluted lake (Lake Nemi, Central Italy) was carried out to identify relationships between this community, depth and some biological indices for water quality assessment. Oligochaetes constituted the bulk of the total macrobenthos in all stations. Nematoda, Chironomidae, Chaoboridae, Stratiomyidae and Psychodidae were also found. Densities and biomasses of the total fauna were low and negatively related to depth and deoxygenation. The unreliability of the absolute numbers of oligochaetes as pollution monitoring criterion is discussed. The relative abundance of this group, the diversity index and the oligochaete/chironomid ratio seem to provide a more convenient picture of lake environmental stress caused by both organic enrichment and long-term anoxia. The pollution tolerance of the tubificid Potamothrix heuscheri is emphasized. (Author's abstract)
W88-10888

COMPARATIVE STUDY OF SPECIES COMPOSITION, DENSITY AND SPECIES DIVERSITY OF THE PHYTOPLANKTON IN A NON-POLLUTED AND A SEWAGE RECEIVING FRESHWATER RESERVOIR,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
B. Gopal, R. K. Trivedy, and P. K. Goel.
Archiv fuer Hydrobiologie, Supplement 79, No. 2/3, p 291-323, February 1988. 12 fig, 5 tab, 76 ref.

Descriptors: *Reservoirs, *Phytoplankton, *Wastewater disposal, *Water pollution effects, *Trophic level, Species composition, Species diversity, Population density, Comparison studies, Jaipur, India, Cyanophyta, Domestic wastes.

Two freshwater reservoirs near Jaipur (India), in the subtropical region, were investigated over a period of two years for the species composition and density of all phytoplankton. One of the reservoirs had received sewage for several years. The number of species and species diversity was greater in the sewage receiving water body, and significant differences were observed in the species composition. A single blue-green alga, Raphidiopsis indica, could account for greater densities of phytoplankton in the non-polluted reservoir than the density in the polluted reservoir. Some trophic state indices were compared to test their usefulness. Only Nygaard's chlorophycan and compound indices differentiated sufficiently between the two water bodies of widely different trophic state. (Sand-PTT)
W88-10890

UNEXPECTED DISAPPEARANCE OF CYANOPHYTE BLOOMS IN PLUSSSEE (NORTH GERMANY),
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W88-10894

GEOCHEMISTRY OF INTERSTITIAL WATER FOR A SEDIMENT CORE FROM THE INDIAN RIVER LAGOON, FLORIDA,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
D. Gu, N. Iricanin, and J. H. Trefy.
Florida Scientist FLSCA, Vol. 50, No. 2, p 99-110, Spring 1987. 2 fig, 2 tab, 30 ref.

Descriptors: *Eutrophication, *Florida, *Indian River, *Estuaries, *Sediment-water interfaces, *Lagoons, Interstitial water, Sediments, Geochemistry, Nitrates, Sulfates, Chlorine, Ammonium, Silica, Phosphates, Sulfides, Metals, Nutrients, Groundwater intrusion, Indian River Lagoon, Florida, Water pollution effects.

Chemical results for interstitial water from organic-rich sediments in the Indian River Lagoon, Florida, show a classic picture of biogeochemical reactions in anoxic environments. Interstitial nitrate was depleted throughout the sediment column and complete sulfate reduction was observed at a depth of <9 cm below the seawater-sediment interface. Interstitial water chlorinity decreased sharply with depth suggesting subsurface occurrence or intrusion of groundwater. Ammonia, phosphate and silica concentrations were high, showing significant nutrient regeneration. Dissolved sulfide levels were also high and play an important role in controlling interstitial water metal concentrations. (Author's abstract)
W88-10899

DOUBLED CO2 CLIMATE AND THE SENSITIVITY OF THE MODELED HYDROLOGIC CYCLE,
National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies.
For primary bibliographic entry see Field 2A.
W88-10908

AQUATIC TOXICOLOGY AND HAZARD ASSESSMENT: EIGHTH SYMPOSIUM.
A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing and Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. 480 p. Edited by Rita Comotto Bahner and David J. Hansen.

Descriptors: *Aquatic toxicology, *Hazard assessment, *Toxicology, *Toxicity, *Environmental protection, *Water pollution effects, *Water pollution prevention, Case studies, Symposium,Water quality control, Legislation, Standards, Environmental protection, Regulations, Research needs, Polychlorinated biphenyls.

ASTM is a voluntary consensus standards development organization. As such, most of the previous seven aquatic toxicology and hazard assessment symposia have focused on presentations relating to research aimed, directly or indirectly, at test methods development. The focus of this Eighth Symposium on Aquatic Toxicology is the utility of these methods in the regulatory and industrial context, their limits of environmental applicability and a continued discussion of improvements in the methods. The symposium begins by examining how scientific data are used and interpreted by the U.S. Congress and by the European Community. The second session examines specific legislative mandates in the United States and the use of particular scientific disciplines in decision-making. The third session of this symposium features a debate about articulating more clearly what must be protected to achieve these environmental goals. The papers featured here focus on an examination of the role of single-species, microcosm and system level responses in decision-making. The goal of all panel members was clearly the protection of aquatic life. The fourth session on research needs responds to the goals outlined in previous papers. In the environmental sciences, knowledge is rarely sufficient and gaps in knowledge are many. Panelists discuss what is needed to fill some of those gaps. The last three sessions discuss on-going research to address some of these needs: (1) whether laboratory data can predict what occurs in the environment, and water quality environment; (2) new concepts and methods in aquatic toxicology; and (3) dioxins - specifically the Times Beach, Missouri, incident. (See W88-10992 thru W88-11027) (Lantz-PTT)
W88-10991

RESEARCH NEEDS FOR RAPID ASSESSMENTS OF CHRONIC TOXICITY,
Kentucky Univ., Lexington. Graduate Center for Toxicology.
For primary bibliographic entry see Field 5G.
W88-10997

RESEARCH NEEDS IN VALIDATING AND DETERMINING THE PREDICTABILITY OF LABORATORY DATA TO THE FIELD,
Colorado State Univ., Fort Collins. Water Resources Lab.
For primary bibliographic entry see Field 7C.
W88-10998

MULTISPECIES TESTS: RESEARCH NEEDS TO ASSESS THE EFFECTS OF CHEMICALS ON AQUATIC LIFE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. P. Giesy.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 67-77, 61 ref.

Descriptors: *Water pollution effects, *Research priorities, *Aquatic toxicology, *Toxicology, *Toxicity, *Aquatic life, *Water quality standards, Xenobiotics, Hazard assessment, Multispecies testing, Statistical studies, Data interpretation, Ecological effects, Aquatic environment.

Aquatic multispecies tests are an extremely flexible and powerful tool in aquatic ecology, especially in the study of the fates and effects of xenobiotics, but are not amenable to the type of protocol development and precision required to be part of a formal hazard assessment scheme. One goal of hazard assessment schemes is to remove the subjectivity of individual researchers from the process. Multispecies tests will not achieve this goal. Instead, aquatic multispecies tests of all sizes and configurations should be used by researchers to answer questions posed about the behavior and effects of xenobiotics in aquatic environments. Therefore, rather than designing experiments to test whether multispecies toxicity tests are accurate or replicable they should be used to elucidate mechanisms and make tests of relevant hypotheses within the overall framework of aquatic ecotoxicology. More research on multispecies replicability is not necessary. Replicability is a statistical problem rather than an intrinsic property, and appropriate tests and designs are available to determine the relative variability, and therefore the sensitivity of laboratory-scale multispecies test, and they allow the appropriate number of stratified replications to be determined to make the test sufficiently replicable to make precise conclusions. Multispecies tests may be more efficient than conducting several single-species tests because of a greater range of sensitivities of test organisms, however, this has not been established. The most useful type of multispecies toxicity tests will be in-situ-type systems where some replication can be accomplished in a more realistic system of multispecies tests of mesocosm-scale. Further research is needed in the area of validation studies of in-situ systems. (See also W88-10991) (Lantz-PTT)
W88-10999

RESEARCH NEEDS IN DEVELOPING STRUCTURE ACTIVITY RELATIONSHIPS,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
R. L. Lipnick.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 78-82, 17 ref.

Descriptors: *Toxicology, *Molecular structure, *Water pollution effects, *Research priorities, *Environmental effects, *Quantitative structure activity relationships, *Aquatic toxicology, Hazard assessment, Model studies, Biological magnification, Aquatic environment, Toxicity.

A short historic overview of the development of quantitative structure activity relationships (QSARs) is presented. Applications of QSARs to problems in environmental toxicology and hazard assessment are reviewed. A number of research needs related to QSAR are identified including: (1) research to quantify the effects of metabolism on a bioconcentration QSAR model; (2) research to determine the upper boundaries of linearity for the bioconcentration QSAR for hydrophobic chemicals; (3) research to refine the understanding of the predictive limitations of the QSAR for acute toxicity of simple nonelectrolytes to aquatic organisms; (4) research to identify additional classes of nonelectrolytes that exhibit increased toxicity caused by more specific mechanisms of binding to biological receptors; and (5) research involving investigations of fundamental mechanisms of toxicity. (See also W88-10991) (Author's abstract)
W88-11000

BIOLOGICAL EFFECTS OF CONTINUOUS AND INTERMITTENT DOSING OF OUTDOOR EXPERIMENTAL STREAMS WITH CHLORPYRIFOS,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
J. Eaton, J. Arthur, R. Hermanutz, R. Kiefer, and L. Mueller.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 85-118, 4 fig, 12 tab, 46 ref.

Descriptors: *Water pollution effects, *Chlorpyrifos, *Biological studies, *Toxicology, *Organophosphorus pesticides, *Pesticides, *Aquatic toxicology, Mississippi River, *Insecticides, Invertebrates, Minnows, Bluegills, Fish physiology, Toxicity, Environmental effects, Acetylcolinesterase, Biological magnification.

Two outdoor experimental streams fed by water pumped from the Mississippi River were dosed with the organophosphorus pesticide chlorpyrifos (the active ingredient of Dursban and Lorsban 4E insecticides) for 100 days, and the responses of individual species and communities compared to those of a control stream. Chlorpyrifos was continuously metered into one stream whereas the other received 8 biweekly additions, each lasting 24 h, at 14 times the concentration in the continuously dosed stream. Therefore, nearly equal amounts of pesticide were introduced into each stream during the experiment. The biological study area of each stream was approximately 245 m long, contained a naturally colonizing plant and invertebrate assemblage, and was stocked with fathead minnows and bluegills. Measured system characteristics included macroinvertebrate drift and riffle benthos composition; fish survival, growth, reproduction, food habits, tissue residues, and acetylcholinesterase inhibition; and system functional process indicators (photosynthesis/respiration ratios, biodegradation, nitrate and dissolved organic carbon concentrations, and bacterial growth and heterotrophic activity). The macroinvertebrate communities reacted similarly in the continuously and pulse-dosed streams. Species diversity decreased by equal amounts and was still decreasing at the end of the test. Crippling of fathead minnows and reversible acute toxicity symptoms (lethargy, tetany when startled) in bluegills were observed only in the pulse-dosed stream. Fish survived, reproduced, and grew equally well in all streams. There seemed to be good agreement between laboratory and field effect concentrations for fish and invertebrates. Functional process indices appeared unaffected and considerably less sensitive than other characteristics. (See also W88-10991) (Author's abstract)
W88-11001

ACCLIMATION AS A FACTOR INFLUENCING METAL CRITERIA,
Corvallis Environmental Research Lab., OR.
G. A. Chapman.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 119-136, 3 fig, 2 tab, 30 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Bioaccumulation, *Toxicology, *Acclimatization, *Sublethal effects, *Water quality standards, *Tolerance, *Aquatic toxicology, Salmon, Zinc, Copper, Cadmium, Chromium, Fish physiology, Biological magnification, Toxicity, Biological studies.

Laboratory research, primarily with salmonid fish, has demonstrated that metal acclimation can increase metal tolerance. Although slight decreases in tolerance have been reported following acclimation, reports of approximate doublings in tolerance predominate. The magnitude of increased tolerance may be metal-specific, and available data suggest the magnitude of acquired tolerance follows the series: Zinc > Copper > Cadmium > Chromium. Tolerance appears to change within a week of major changes in acclimation concentration. The significance of acclimation-induced tolerance may be important to the survival of organisms in metal contaminated environments, but the magnitude of the tolerance change is probably within the range of many other factors influencing the accuracy of criteria. For example, the use of mean concentrations to express cycling exposure may underestimate chronic toxicity by a factor of two. Metal speciation/complexation is probably much more important to criteria accuracy than acclimation. Another important aspect of criteria evaluation is the relative resolution of laboratory tests and field monitoring. The problem of detecting biological effects following criteria violations is discussed. (See also W88-10991) (Author's abstract)
W88-11002

COMPARISON OF QSAR PREDICTIONS WITH FISH TOXICITY SCREENING DATA FO 110 PHENOLS,

Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
R. L. Lipnick, C. K. Bickings, D. E. Johnson, and D. A. Eastmond.

IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 153-176, 4 fig, 2 tab, 19 ref.

Descriptors: *Toxicology, *Water pollution effects, *Aquatic toxicology, *Toxicity, *Fish, *Phenols, *Water quality control, Quantitative structure activity relationship, Lethal limits, Aminophenol, Molecular structure, Fish physiology.

A comparison was made between the predicted 96-hr guppy LC50 of 110 phenols based upon QSAR (quantitative structure activity relationship) equations of Saarikoski and Viluksela and the data from 936 toxicity screening tests for these chemicals. Test data on up to eight species of freshwater fishes were available per compound. Overall, the experimental toxicity dat on these chemicals were consistent with the QSAR predictions. The 110 phenols occupy a considerably larger range of spanned substituent space than the QSAR training set. One compound, 4-aminophenol, exhibited lethality at test concentrations of 35 times below that predicted. The increased fish toxicity of this compound is explained in terms of a proelectrophile molecular mechanism, in which the parent compound is metabolically oxidized to a para quinoid structure. The resulting electrophilic metabolite is susceptible to attack by nucleophilic moieties present in biological macromolecules leading to covalent bond formation and inhibitions of biochemical processes. (See also W88-10991) (Author's abstract)
W88-11004

FIELD CONFIRMATION OF A LABORATORY-DERIVED HAZARD ASSESSMENT OF THE ACUTE TOXICITY OF FENTHION TO PINK SHRIMP, PENAEUS DUORARUM,

Environmental Research Lab., Gulf Breeze, FL.
P. W. Borthwick, J. R. Clark, R. M. Montgomery, J. M. Patrick, and E. M. Lores.

IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 177-189, 1 fig, 3 tab, 18 ref.

Descriptors: *Toxicology, *Aquatic toxicology, *Water pollution effects, *Toxicity, *Toxicology, *Insecticides, *Lethal limits, *Fenthion, *Shrimp, Lethal limits, Mortality, Field tests, Hazard assessment.

Field studies were conducted to determine if laboratory protocols accurately predict shrimp mortality under field conditions. To evaluate the applicability of laboratory data, fenthion, a mosquitocide, was applied to coastal black rush (Juncus roemerianus) marshes in several truck-mounted ultra-low volume (ULV) adulticide operations and by direct application at the larvicide rate. Caged pink shrimp (Penaeus duorarum) were deployed in floating compartmented cages and observed frequently over a 24-h period for mortality. Field data were compared to laboratory acute toxicity data from ASTM standard practice flow-through tests. The acute flow-through 96-h LC50 of 0.11 micrograms/L was used as a conservative estimate of the expected toxicity in field exposures. An exposure profile based on measured field concentrations was used for laboratory pulse-exposure tests; fenthion was metered for 2 h to specified maximum concentrations, then flushed with seawater to cause a 6- to 8-h exposure, yielding a no-observed-effect concentration (NOEC) of 0.84 micrograms/L. In field tests, four ULV operations produced initial water concentrations < NOEC and no fenthion-induced shrimp mortality. However, the direct application's initial water concentrations ranged from 15 to 20 micrograms/L (> NOEC) and caused extensive mortality (90 to 100%) in the caged shrimp. Thus, field observations confirmed the hypothesis that if fenthion time-exposure concentrations were lower than the laboratory NOEC, then no mortality would occur in caged shrimp. Moreover, if initial concentrations in the field exceeded the laboratory NOEC, mortality would occur. These laboratory tests and field applications indicate that laboratory toxicity tests can predict the range of lethal and nonlethal acute exposures to fenthion for pink shrimp when exposure regimes are similar. (See also W88-10991) (Author's abstract)
W88-11005

TIME/TOXICITY RELATIONSHIPS IN SHORT-TERM STATIC, DYNAMIC, AND PLUG-FLOW BIOASSAYS,

SRI International, Menlo Park, CA. Aquatic Toxicology Program.
For primary bibliographic entry see Field 7C.
W88-11006

ACUTE TOXICITY OF CHLORINE ON FRESHWATER ORGANISMS: TIME-CONCENTRATION RELATIONSHIPS OF CONSTANT AND INTERMITTENT EXPOSURES,

MITRE Corp., McLean, VA.
M. P. Wang, and S. A. Hanson.

IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 213-232, 9 fig, 4 tab, 24 ref. EPA Contract 68-01-6403.

Descriptors: *Water pollution effects, *Toxicity, *Aquatic environment, *Wastewater treatment, *Toxicology, *Chlorine, *Aquatic toxicology, Model studies, Mortality, Mathematical studies, Kinetics, Concentration time.

The effect of chlorine exposures on the survival of freshwater aquatic life is of major concern within many of the waterbodies in the United States. Continuous chlorine exposures are a typical result of effluent releases from wastewater treatment plants. Intermittent chlorine exposures are representative of the 'blow down' antifouling procedure used for cooling towers in power plants. This paper presents the derivation and resulting mathematical expressions for the time-concentration relationship of chlorine exposure and survival of freshwater aquatic organisms. Two topics are discussed: the time-concentration toxicity relationship for constant chlorine exposures and the prediction from the constant exposure mathematical expressions of toxicity caused by intermittent exposures. An extensive literature review provided the database from which mathematical time-concentration relationships were derived for constant chlorine exposures. Relationships were analyzed for individual species. The resistance of all the different species increased significantly from a 96-h exposure period to an 8-h exposure period. The intermittent chlorine exposure tests differ not only in the frequency and duration of the chlorine dose but also in the geometric form of the dose application. A kinetic model, which accounted for these variabilities, was used to predict intermittent exposure mortality. The parameters of the model were obtained from the analysis of constant exposure results. In addition to predicting mortality resulting from variable exposure patterns, the kinetic model may be used to design appropriate test durations for intermittent chlorination experiments. (See also W88-10991) (Author's abstract)
W88-11007

SENSITIVITY OF CHRONIC ENDPOINTS USED IN DAPHNIA MAGNA STRAUS LIFE-CYCLE TESTS,

Dow Chemical U.S.A., Midland, MI. Mammalian and Environmental Toxicology.
F. M. Gerish, D. L. Hopkins, S. L. Applegath, C. G. Mendoza, and D. P. Milazzo.

IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 245-252, 5 tab, 24 ref.

Descriptors: *Sensitivity analysis, *Daphnia, *Water pollution effects, *Bioassay, *Toxicity, *Aquatic toxicology, *Survival, *Toxicology, Boric acid, Ammonia, Triclopyr triethylamine salt, Sublethal effects, Spawning, Animal growth, Ecological effects.

The sensitivity of three endpoints used to evaluate the chronic toxicity of boric acid, un-ionized ammonia, and triclopyr triethylamine salt (TEA salt) to Daphnia magna was examined. The endpoints examined during these studies were reproduction, growth, and survival. A 21-day static renewal toxicity test was conducted with Daphnia magna for all three test materials. The maximum acceptable toxicant concentrations (MATCs) derived from these studies were boric acid 6.4 < MATC < 13.6 mg B/L, unionized ammonia 0.42 < MATC < 0.87 mg NH3-H/L, and triclopyr TEA salt 80.7 < MATC < 149.0 mg/L. Reproduction was consistently the most sensitive endpoint in all three studies. An examination of the literature indicates that the utility and relative sensitivity of reproduction and survival as chronic endpoints have been questionable because of erratic adult survival and large amounts of reproductive variation. The data from this study show that use of well nourished and healthy test organisms reduces variability in both reproduction and survival and enhances the reliability of the daphnid chronic test. (See also W88-10991) (Author's abstract)
W88-11009

AQUATIC HAZARD ASSESSMENT: PICLORAM,

Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
M. A. Mayes, and G. R. Oliver.

IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 253-269, 1 fig, 3 tab, 46 ref.

Descriptors: *Toxicology, *Aquatic toxicology, *Hazard assessment, *Picloram, *Water pollution effects, *Fate of pollutants, Herbicides, Organic compounds, Toxicity, Fish, Lethal limits, Marine environment, Oysters, Minnows, Ecological effects.

Picloram (4-amino-3,5,6-trichloropicolinic acid) exhibits herbicidal activities on broadleaf weeds and woody plants and is registered under the trademarks of TORDON, GRAZON, and AMDON herbicides. It is an organic acid (pKa = 3.2); thus at environmental pH ranges it is usually found in the ionized anionic form. Other physicochemical characteristics of picloram are water solubility 430 mg/L and vapor pressure 6.6 times 10 to the 7th power mm mercury at 35 C. The rate of dissipation of picloram in soil is dependent on the application rate, soil type, and climate. Picloram is classified as having moderate mobility in soil; however, the runoff potential of picloram is normally limited to < 5% of the applied chemical removed from the site in runoff waters. Picloram is relatively nontoxic to freshwater fishes, with acute LC50 values for technical acid ranging from 4.3 mg/L for lake trout to 55.3 mg/L for fathead minnows. Freshwater invertebrates show similar suscepitibility to technical picloram with acute LC50 values ranging from 27 mg/L for Gammarus lacustris to 68.3 mg/L for Daphnia magna. The most sensitive marine invertebrates tested is the eastern oyster with 18 < EC50 < 32 mg/L when exposed to a potassium salt formulation of picloram. Because of its relatively low toxicity to aquatic organisms and low

potential for substantial quantities to enter the aquatic environment, picloram is not expected to present a hazard to the aquatic environment. (See also W88-10991) (Author's abstract)
W88-11010

EFFECTS OF TRIETHYLENE GLYCOL ON MYSIDOPSIS BAHIA (CRUSTACEA: MYSIDACEA) AND MENIDIA PENINSULAE (PISCES: ATHERINIDAE),
University of West Florida, Pensacola. Dept. of Biology.
R. M. Montgomery, J. Forester, and C. N. D'Asaro.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 270-276, 3 tab, 11 ref.

Descriptors: *Toxicology, *Water pollution effects, *Triethylene glycol, *Mysids, *Silversides, *Aquatic toxicology, Fish, Crustaceans, Ecological effects, Toxicity, Population dynamics.

Chronic effects of triethylene glycol (TEG), a chemical frequently used as a carrier-solvent in toxicity tests, were investigated in a 23-day life-cycle toxicity test with a mysid (Mysidopsis bahia) and in a 28-day early life-stage toxicity test with the tidewater silverside (Menidia peninsulae). Test organisms were exposed to the same range of concentrations: seawater control, 3.2, 10, 32, 100, 320, and 1000 mg/L. Effects, if any, were measured by survival and reproduction for the mysids and survival and growth for the silversides. It was concluded that no direct adverse effect should be expected as a result of using TEG at concentrations as high as 100,000 times (mysids) and 360 times (tidewater silversides) those recommended in ASTM drafts of standard practices (< or = to 0.01 microL/L in Mysidopsis bahia life-cycle tests and < or = to 0.01 microL/L in tests with early life-stages of Menidia peninsulae) and that either a seawater or a TEG control may not be necessary. (See also W88-10991) (Author's abstract)
W88-11011

INTERLABORATORY COMPARISON OF THE ASTM BIOCONCENTRATION TEST METHOD USING THE EASTERN OYSTER,
Environmental Protection Agency, Narragansett, RI.
S. C. Schimmel, and R. L. Garnas.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 277-287, 6 tab, 12 ref.

Descriptors: *Toxicology, *Water pollution effects, *Comparison studies, *Oysters, *Biological magnification, *Aquatic toxicology, Organic compounds, Pentachlorophenol, Trichlorobenzene, Diphenyldichloroethane, Toxicity.

Summarized are the results of an interlaboratory comparison conducted by four laboratories for bioconcentration factor (BCF) testing using the eastern oyster (Crassostrea virginica) and the organic chemicals pentachlorophenol (PCP), 1,2,4-trichlorobenzene (TCB), and p,p'-DDE. The bioconcentration test method used was Draft 9 ot ATSM Proposed Standard Practice for Conducting Bioconcentration Tests with Fishes and Saltwater Bivalve Mollusks. The mean steady state BCFs and high to low BCF ratios (H/L ratio) for PCP, TCB, and p,p'-DDE were 64 (2.4), 168 (2.3), and 52,600 (3.4), respectively. The mean high to low ratio for all three chemicals was 2.7, which represents the extreme estimate of variability. The mean H/L ratios for the time to 90% uptake were 6.2 for PCP and 5.8 for TCB while the ratio for time to 90% depuration for all three chemicals was 3.3. The results were reproducible, considering the varying degrees of experience between participants in conducting BCF tests, the wide geographic distribution between participants, and the different dilution water characteristics. (See also W88-10991) (Author's abstract)
W88-11012

TOXICITY OF AQUEOUS EXTRACTS OF NATURAL AND SYNTHETIC OILS TO THREE SPECIES OF LEMNA,
Murray State Univ., KY. Dept. of Biological Sciences.
J. M. King, and K. S. Coley.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 302-309, 2 fig, 38 ref. EPA Contract R809946.

Descriptors: *Toxicology, *Oil pollution, *Water pollution effects, *Toxicity, *Bioassay, *Aquatic plants, *Duckweed, Aquatic environment, Synthetic oils, Algae, Oil, Biological studies.

This study was designed to determine the acute toxicity of natural and synthetic oils to three species of Lemna. The major objectives were to determine if members of this genus can be efficiently used as bioassay organisms and if their growth responses to these oils were similar to those reported for algae. The experimental approach involved exposure of L. gibba, L. minor, and L. perpusilla under standard laboratory conditions to two crude oils, a fuel oil, and two coal-liquefaction products. Growth was monitored as changes in frond numbers. The results of this study showed that the coal-liquefaction products had a greater acute toxicity than the natural oils to the three species, which were similar to results obtained with algae. Also, the three species proved to be efficient and effective bioassay organisms. (See also W88-10991) (Author's abstract)
W88-11014

COMPARISON OF TECHNIQUES FOR EVALUATING THE EFFECT OF CADMIUM ON PSEUDOMAS FLUORESCENS,
Toronto Univ. (Ontario). Dept. of Microbiology.
P. L. Seyfried, and C. B. L. Horgan.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 310-320, 1 fig, 39 ref.

Descriptors: *Toxicology, *Water pollution effects, *Cadmium, *Pseudomonas fluorescens, *Aquatic toxicology, Biological studies, Adenosine triphosphate, Bioassay, Bacteria, Comparison studies, Hazard assessment.

Three techniques were compared in a study of the effect of cadmium on an aquatic strain of Pseudomonas fluorescens. The methods used were: (1) direct microscopic counts using epifluorescence and formazan detection; (2) determination of colony-forming units; and (3) determination of intracellular adenosine triphosphate (ATP) using a firefly luciferase bioluminescent assay. Results of the plate count and ATP determinations demonstrated that P. fluorescens was stressed after exposure to 10-, 25-, 50-, and 100-ppm cadmium. The organisms recovered following treatment; however, only the ATP bioassay data indicated that there might be bacterial recovery at 12 h after the addition of 100-ppm Cd. The acridine orange 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chlorine (INT) formazan reduction technique did not produce results that could be readily interpreted. the bacteria tended to clump together, and cells that had been exposed to 100-ppm Cd generally did not fluoresce. In addition, it was not possible to detect formazan deposits in any of the Cd-treated cells. Compared to the plate count procedure and the acridine orange INT-formazan reduction technique, the intracellular ATP assay appeared to be a more accurate method of determining the viability of P. fluorescens cells following Cd treatment. (See also W88-10991) (Author's abstract)
W88-11015

ADVANTAGES OF USING REGRESSION ANALYSIS TO CALCULATE RESULTS OF CHRONIC TOXICITY TESTS,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 7C.
W88-11017

EFFECTS OF AN ACIDIC RIVER, CAUSED BY ACIDIC RAIN, ON WEIGHT GAIN, STEREOIDOGENESIS, AND REPRODUCTION IN THE ATLANTIC SALMON (SALMO SALAR),
Department of Fisheries and Oceans, Halifax (Nova Scotia). Halifax Fisheries Research Lab.
H. C. Freeman, and G. B. Sangalang.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 339-349, 6 fig, 2 tab, 28 ref.

Descriptors: *Toxicology, *Acid streams, *Spawning, *Water pollution effects, *Acid rain, *Aquatic toxicology, *Salmon, *Fish physiology, Westfield River, Nova Scotia, Medway River, Growth, Population dynamics, Hydrogen ion concentration, Comparison studies, Fish eggs, Mortality.

In 1981, wild male Atlantic salmon (Salmo salar) captured in the low pH (pH 4.7) Westfield River, Nova Scotia, Canada, had lower plasma androgen levels at sexual maturity compared to levels in wild male salmon sampled in the nearby less acidic (pH 5.6) Medway River. In 1982, Atlantic salmon held in cages and fed daily in the Westfield River (pH range 5.1 to 5.3) during the last three months of their sexual maturation cycle gained less weight, produced smaller eggs, and had abnormal steroid hormone metabolism compared to similar fish held in the less acidic Medway River (pH range 5.4 to 6.1). The mortality of eggs taken and fertilized from salmon held in the Westfield River exceeded 90% while the mortality of eggs from the Medway River salmon was 59%. (See also W88-10991) (Author's abstract)
W88-11018

EFFECTS OF SUSPENDED VOLCANIC ASH AND THERMAL SHOCK ON SUSCEPTIBILITY OF JUVENILE SALMONIDS TO DISEASE,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
T. M. Poston, D. A. Neitzel, C. S. Abernethy, and D. W. Carlile.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 359-374, 5 fig, 2 tab, 21 ref, append. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Water pollution effects, *Volcanic ash, *Thermal pollution, *Fish diseases, *Diseases, *Trout, *Salmon, *Aquatic toxicology, Flexibacter columnaris, Toxicity, Fish.

Susceptibility of salmonids to the fish pathogen, Flexibacter columnaris, was used to assess sublethal stress following exposures to two environmental stressors, thermal shock, and suspended volcanic ash. Juvenile rainbow trout (Salmo gairdneri) were more susceptible to disease following exposure to 0.3- and 11.5 g/L suspended volanic ash. The response was dose dependent. Exposure of juvenile chinook salmon (Oncorhynchus tshawytscha) to thermal shock did not result in increased susceptibility to disease. In several tests, thermally

exposed fish were less susceptible to disease than control fish. (See also W88-10991) (Author's abstract)
W88-11020

APPROPRIATE DURATIONS AND MEASURES FOR CERIODAPHNIA TOXICITY TESTS,
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
D. C. McNaught, and D. I. Mount.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 375-381, 2 fig, 3 tab, 2 ref. EPA Grant 810775.

Descriptors: *Toxicology, *Aquatic animals, *Bioassay, *Water pollution effects, *Daphnia, *Toxicity, *Aquatic toxicology, Biological studies, Temperature, Population dynamics, Invertebrates.

The objectives of this analysis of the Mount-Norberg Ceriodaphnia toxicity test were to improve its application to specific ecosystems and to shorten the duration required to obtain significant results. The three-brood seven-day toxicity test using Ceriodaphnia grown at 25 C became a 28-day test at 18 C. Using typical ecosystem temperature is an important aspect of this test when applied to specific locations. Generally Ceriodaphnia can be grown at temperatures of 12 to 25 C; too few neonates were produced at 6 C for useful test results. The synchronous release of neonates by parthenogenic females may be used in determining when to sample offspring and thus reduce the cost of testing complex effluents. The intrinsic growth rate of these animals may be used instead of their net reproductive rate to provide answers in a shorter time, with smaller coefficients of variation. (See also W88-10991) (Author's abstract)
W88-11021

RAPID AQUATIC TOXICITY ASSAY USING INCORPORATION OF TRITIATED-THYMIDINE INTO SEA URCHIN, ARBACIA PUNCTULATA, EMBRYO: EVALUATION OF TOXICANT EXPOSURE PROCEDURES,
JRB Associates, Inc., Narragansett, RI. Marine Services Branch.
D. E. Nacci, and E. Jackim.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 382-394, 2 fig, 2 tab, 32 ref.

Descriptors: *Toxicology, *Water pollution effects, *Aquatic toxicology, *Toxicity, *Bioassay, *Sea urchin, *Thymidine, Population dynamics, Radiochemical analysis, Embryos, Tritium, Deoxyribonucleic acid, Echinoderms, Minnows, Lethal limits.

Toxicity of substances in seawater was measured using growth inhibition of embryonic sea urchins during a short period after fertilization. Growth of Arbacia punctulata embryos was monitored by incorporation of tritium-labeled thymidine, a nucleoside incorporated into newly synthesized deoxyribonucleic acid (DNA). Sensitivity and ranking ability of this rapid Arbacia embryo test were judged by comparison of toxicity values for several organic industrial chemicals using this test and two standard acute aquatic toxicity tests. Median effective toxicity values (EC50 values) for early embryos compared favorably to median lethal values (LC50 values) obtained in standard acute toxicity tests using Pimephales promelas (fathead minnow) and Daphnia magna (water flea). This paper presents a Toxicant exposure began before, at the time of, or after fertilization and continued for 4 h following fertilization. In addition to the eight organic chemicals tested for comparison to acute toxicity values for other species, several chemicals with embryotoxic potentials (tumor promoters and teratogens) were tested to determine differential sensitivities of exposed life-stages: unfertilized egg, fertilization, and early embryo. EC50 values for any one substance were not significantly changed by exposure modification. Toxicity values for exposures that included fertilization as well as early embryo growth were at least as sensitive as post-fertilization exposure values for all compounds tested except one. Because of technical ease and potential sensitivity, toxicant exposure that includes fertilization as well as early embryo growth (but not unfertilized egg exposure) is recommended for future testing. Additional development, refinement, and standardization of this fertilization and early embryo test should further increase its utility in toxicity testing. Because this test requires only 4 h exposure and can be correlated with standard measurements of toxicity, it could be used in early stage hazard evaluation in conjunction with other aquatic bioassays. (See also W88-10991) (Author's abstract)
W88-11022

ACUTE AND CHRONIC TOXICITY TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS, OF EFFLUENTS FROM A TREATMENT PLANT RECEIVING DYE AND PIGMENT PROCESSING WASTEWATER,
Environmental Research Lab.-Duluth, Cincinnati, OH. Newtown Fish Toxicology Station.
Q. H. Pickering, G. M. Shaul, and K. A. Dostal.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 395-406, 4 tab, 22 ref.

Descriptors: *Toxicology, *Water pollution effects, *Toxicity, *Fathead minnows, *Dye industry wastes, *Lethal limits, *Industrial wastewater, Wastewater treatment, Aquatic toxicology, Sublethal effects, Ecological effects, Environmental effects, Larvae, Activated sludge, Activated carbon.

Ninety-six hour, static acute, and continuous-flow early life-stage (ELS) chronic toxicity tests, using the fathead minnow (Pimephales promelas), were conducted to evaluate the toxicity of effluents from a pilot scale activated sludge (AS) treatment system receiving dye and pigment wastewater. In the first test with a powdered activated carbon (PAC) dosage of 1800 mg/L of influent, survival was the most sensitive measure of effect in the ELS test. No adverse effect on survival or growth was observed at lower effluent concentrations (5.0 to 0.63%). The maximum acceptable toxicant (effluent) concentration (MATC) was between 10 and 5%. Ten 96-h median lethal concentration (LC50) values from static acute tests ranged from 12.9 to $> 80\%$. In the second test at a PAC dosage of 1000 mg/L of influent, growth was the most sensitive measure of effect in the ELS test. Larval growth was significantly reduced at the highest effluent concentration tested (20%). The MATC was between 20 and 10%. Seven 96-h LC sub 50s from static acute tests ranged from 28.3 to $> 80\%$. The effluent from the treatment system receiving the higher PAC dosage of 1800 mg/L was more toxic than the effluent from the treatment system receiving the lower PAC dosage of 1000 mg/L. However, the influent to the treatment system receiving the higher level of PAC also was more acutely toxic. (See also W88-10991) (Author's abstract)
W88-11023

USE OF MULTIPLE PATHWAY COMPUTER CODES FOR ASSESSMENT OF HEALTH EFFECTS FROM LOW-LEVEL RADIOACTIVE WASTE,
Rogers and Associates Engineering Corp., Salt Lake City, UT.
R. B. Klein, D. E. Bernhardt, and V. C. Rogers.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 327-338, 1 fig, 3 tab, 3 ref.

Descriptors: *Radioactive waste disposal, *Path of pollutants, *Computer programs, *Water pollution effects, *Public health, Geohydrology, Groundwater pollution, Surface water, Air pollution, Well water, Fish, Population exposure, Case studies, Landfills, Groundwater movement, Uranium, Adsorption, Simulation, Decision making.

The PATHRAE computer code, developed for the U.S. Environmental Protection Agency, is utilized to predict environmental impacts and health effects to man resulting from environmental movement of radionuclides under a variety of hydrogeologic and climatic conditions. This code assesses migration of radionuclides via groundwater, surface water, atmospheric and biotic pathways. Peak and long-term concentrations of radionuclides are calculated in well water, surface water, air, crops, animals, and fish accessible to human receptors. Uptake and dose-conversion factors are then used to compute health effects to these humans. Capabilities and limitations of the code are discussed. Two specific cases are presented to demonstrate application of PATHRAE. The first site is a landfill where thorium/uranium-ore residuals were deposited and the underlying soils had low permeability and high adsorptive capacity. Groundwater flow for this site is through the bulk medium by Darcy flow. The second site is a uranium mill-tailings pond situated above an aquifer whose transmission of water is dominated by fracture flow, and where the geologic medium has only limited acid-buffering adsorptive properties. Computer codes such as PATHRAE are well-suited for evaluating the benefits from remedial action alternatives. Results from computer runs that simulate various site and/or aquifer conditions can be compared. If utilized in this fashion, computer codes can be an important tool for decision making relative to radioactive waste materials. (See also W88-11031) (Author's abstract)
W88-11051

EXAMPLE OF THE INFLUENCE OF DEGREE OF CHLORINATION ON SUBSURFACE MIGRATION OF POLYCHLORINATED BIPHENYLS AND RELATED COMPOUNDS,
IT Corp., Houston, TX.
For primary bibliographic entry see Field 5B.
W88-11198

IRON DISSOLUTION RESULTING FROM PETROLEUM-PRODUCT CONTAMINATION IN SOIL AND GROUND WATER. 1. THERMODYNAMIC CONSIDERATIONS,
Weston (Roy F.), Inc., Albuquerque, NM.
For primary bibliographic entry see Field 5B.
W88-11229

HEALTH ASPECTS OF EUTROPHICATION,
National Inst. for Water Research, Pretoria (South Africa).
W. E. Scott, R. A. Van Steenderen, and D. I. Welch.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-225645. Price codes: E04 in paper copy, E04 in microfiche. 1985. 12 p, 1 fig, 1 tab, 44 ref.

Descriptors: *Eutrophication, *Public health, *Water pollution effects, *South Africa, Phosphates, Water supply, Water quality, Algae, Cyanophyta, Bacteria, Biomass, Algal toxins, Organohalides, Population exposure.

Phosphate, a key nutrient in eutrophication, may be indirectly responsible for various health problems in water supplies. Health problems may be connected with the development of large amounts of plant biomass in the form of algal or cyanobacterial blooms. The two features of algae-rich waters which are most likely to have health implications are, first, production of various cyanobacterial toxins, and second, organohalide formation after treatment by chlorination. Antibacterial substances produced by certain algae may on the other hand be responsible for an improvement in water quality. (Author's abstract)
W88-11270

Group 5C—Effects Of Pollution

ACID RAIN: IMPLICATIONS FOR THE LAKE STATES FORESTS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. S. Shriner.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-009821. Price codes: A02 in paper copy, A01 in microfiche. Report No. CONF-8704129--1, (1986). 17 p, 3 fig, 21 ref. USDA/FS Contract 1736-1736-A1, DOE Contract DE-AC05-840R21400, and USDA Contract 23-106.

Descriptors: *Acid rain, *Water pollution effects, *Forests, Environmental effects, Air pollution, Sulfur dioxide, Ozone, Nitrogen oxide, Ecological effects, Sulfur, Vegetation, Eastern United States, Plant pathology, Synergistic effects.

While there is no direct evidence at this time that acidic deposition or sulfur or nitrogen oxide (NO sub x) gases at ambient levels in the eastern United States are responsible for observed changes in forest condition, the potential for indirect effects on future forest productivity remains unresolved. Another secondary pollutant, ozone (O3), has been demonstrated to be capable of causing regional-scale impacts on forest productivity in certain regions. This paper provides a general overview of the 'acid rain' issue, summarizes a new research initiative investigating the role of sulfur deposition on the condition of Lake States hardwood forests, and discusses the potential implications of acid rain on Lake States forests, given current levels of uncertainty. Research to date indicates that: (1) The short-term effect of acid rain directly on individual trees is unlikely to result in significant adverse growth effects by itself; (2) The long-term impacts of acidic precipitation are likely to be subtle, difficult to measure, and the result of a variety of mechanisms that could be expected to vary from site to site. Alteration of nutrient cycling processes and species competition in forest ecosystems are potential mechanisms of long-term effects; (3) The potential interactions of acidic precipitation with existing conditions must be considered. Ozone, drought, climate extremes, insects, and diseases all represent major stress factors in forest ecosystems that have co-occurred with air pollution in Lake States forests over the past several decades; (4) Vegetation injury typical of O3 injury has been observed over extensive areas of eastern Wisconsin and in Michigan; and (5) There is evidence that prolonged seasonal exposure over long periods of time to air pollutants such SO2 and O3 may result in genetic selection. (Lantz-PTT)
W88-11273

FIELD AND LABORATORY STUDY USING ADENYLATE ENERGY CHARGE AS AN INDICATOR OF STRESS IN MYTILUS EDULIS AND NEPHTYS INCISA TREATED WITH DREDGED MATERIAL,
Environmental Research Lab., Narragansett, RI.
G. E. Zaroogian, P. F. Rogerson, G. Hoffman, M. Johnson, and D. M. Johns.
Available from the National Technical Information Service, Springfield, VA. 22161, as ADA 157374. Price codes: A04 in paper copy; A01 in microfiche. Technical Report D-88-4, June 1988. Final Report. 164 p, 41 fig, 26 tab, 46 ref, 2 append.

Descriptors: *Water pollution effects, *Mytilus edulis, *Nephtys incisa, *Dredging, *Adenylate energy charge, Nucleotides, Mussels, Polychaetes, Adenosine triphosphate, Tissue analysis, Biological studies.

A study was conducted to test the applicability of adenylate energy charge (AEC) and adenine nucleotide pool concentrations as measures of biological response in the blue mussel, Mytilus edulis, and the marine polychaete, Nephtys incisa, after exposure in the laboratory and field to contaminated dredged material from Black Rock Harbor (BRH), Bridgeport, Conn. A second objective was to include field verification of laboratory results, and a third objective was to investigate residue-effect relationships between tissue concentrations of BRH contaminants and AEC and adenine nucleotide pool concentrations. Biological responses were measured in a laboratory dosing system that provided constant exposure concentrations of suspended BRH sediment ranging from 0 to 10 mg/L for M. edulis and 0 to 200 mg/L for N. incisa. Tissue residue concentrations, particularly of persistent compounds such as polychlorinated biphenyls, were found to be closely related to exposure concentration. This close relationship between exposure concentrations and tissue residues, as defined in laboratory experiments, was used to estimate field exposures based on tissue residues measured in experiments, was used to estimate field exposures based on tissue residues measured in field-collected M. edulis and N. incisa. The field exposure estimated from tissue residues were corroborated using estimates based on water and sediment chemistry. The biological responses evaluated in this report included the adenine nucleotide measures of adenosine triphosphate, adenosine diphosphate, adenosine monophosphate, adenylate pool, and AEC. The only significant laboratory response was a reduction in adenylate pool concentration measured in M. edulis at BRH exposure concentrations higher than any estimated exposures in the field. The only significant field responses were station-related changes in all adenylate nucleotide concentrations measured in N. incisa 16 weeks postdisposal and were indicative of nonstressed organisms. (Lantz-PTT)
W88-11279

ENVIRONMENTAL EFFECTS OF RADIATION EMERGENCIES,
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
For primary bibliographic entry see Field 4C.
W88-11281

ECONOMIC CONSIDERATIONS OF ATMOSPHERIC DEPOSITION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. S. Shriner.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-010714. Price codes: A02 in paper copy, A01 in microfiche. Oak Ridge National Laboratory Report No. DOE/OR/21400--T307, (1987). 5 p, 3 fig. DOE Contract DE-AC05-84OR21400.

Descriptors: *Economic aspects, *Acid rain, *Economic impact, Welfare, Cost-benefit analysis, Decision making, Water pollution control, Industrial wastes.

Acidic deposition is presumed to be associated with the long- and short-range transport, dispersion, and wet and dry removal processes of pollutants emitted to the atmosphere from fossil-fuel-fired facilities. As such, it is usually difficult to relate acidic deposition at a downwind receptor area to a specific source or source region. As a result, policy decisions for the control of atmospheric pollutants are required at the national, rather than regional level. Further, these decisions must rest on scientific evidence as to whether the control and mitigation options are economically and environmentally acceptable. This discussion addresses some of the major considerations of the acidic deposition issue which will impact an economic analysis. An economic analysis can be divided into two categories: welfare analysis and impact analysis. Welfare analysis involved estimation of receptor-specific benefits of a change in levels of atmospheric deposition. Impact analysis involves the translation of receptor-specific benefits to estimates of regional changes in income, employment, and population due to various emissions control policies and, ultimately, to changes in consumer surplus and gross national product. Of the two, welfare analysis is the most problematic because: (1) all of the benefits estimates for individual receptor systems do not take into account price adjustments in other sectors of the economy which may occur as an indirect result of emissions reduction policies; and (2) the welfare measures used in the individual receptor systems are not always theoretically consistent with one another. The lack of consistency in regional delineations used for the different receptor systems will make it difficult to aggregate the benefits estimates for each receptor system into regional totals. This, in turn, will place certain limits on the scope of the distributional analysis that can be performed relative to policy-induced changes in the welfare of consumers and producers in different regions. This aspect of regional equity makes the solution of environmental problems, such as acidic rain which cross socio-political boundaries, a complex challenge in the translation of science into public policy. (Lantz-PTT)
W88-11282

5D. Waste Treatment Processes

INFLUENCE OF A FRESHWATER RIVERINE MARSH FOR TERTIARY WASTEWATER TREATMENT IN THE UPPER BASIN OF THE B. EVERETT JORDAN RESERVOIR,
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
C. L. Green.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8624131. Ph.D. Dissertation, 1986. 147 p, 106 fig, 19 tab, 56 ref.

Descriptors: *Water quality, *Phosphorus, *Marshes, *Tertiary wastewater treatment, Wetlands, Catchment areas, Sinks, Reservoirs, Phosphorus removal, Precipitation, Hydrogen ion concentration, Dissolved oxygen, Stream discharge, conductivity, Biological oxygen demand.

The relative quantities of phosphorus entering and exiting Basin IV of the Lake Jordan Reservoir, North Carolina were determined based on the hydrological inputs and outflows to Basin IV and annual precipitation, previous and present phosphorus influxes and outputs, and whether the conditions imposed by the surrounding wetland creates a phosphorus sink. Samples were collected for two water years at nine sampling sites within the drainage basin of Basin IV. Seasonal total phosphorus concentrations at eight sample sites were considerably higher during the fall. Mass total phosphorus deposition from seven waste treatment facilities discharging into the primary tributaries were reduced as flow moved through the basin exiting into Basin III. Mass total phosphorus concentrations in Basin IV during the two water years were dependent upon season, precipitation and runoff, and the volume of point source effluent discharges. Periods of mild temperature resulted in decreased mass total phosphorus volumes; periods of increased precipitation and runoff created a dilution effect in which mass total phosphorus volumes were decreased; and periods of low temperatures and decreased precipitation and runoff with constant point source effluent discharge were responsible for increased mass total phosphorus volumes. (Cremmins-AEPCO)
W88-10089

WASTE DISCHARGE TO LAND AND ITS RELATIONSHIP TO WATER QUALITY IN CALIFORNIA,
California Univ., Los Angeles. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5F.
W88-10098

WATER CLARIFICATION,
J. P. Lambert, and M. L'Huillier.
U.S. Patents No. 4,456,534; June 26, 1984, 5 p, 2 ref. Official Gazette of the United States Patent Office, Vol. 1043, No. 4, p 1607, June 26, 1984.

Descriptors: *Patents, *Wastewater treatment, *Clarified wastewater, *Polymers, Calcium chloride, Clarification, Flocculation, Separation techniques, Suspended solids, Industrial waste.

A process was developed for clarifying wastewater containing one or more synthetic carboxylated styrene-butadience copolymers in latex form alone or in admixture with one or more other synthetic polymers in latex form. A wastewater stream is fed to a container equipped for agitation. The wastewater is maintained in the container in an agitated condition for at least about 3 minutes and

up to about 3 hours while adding an aqueous stream of calcium chloride sufficient to provide a concentration of about 200 to 3000 ppm based on the total in the container and a liquid or aqueous stream of a cationic flocculant. The flocculant is selected from the class consisting of quaternary nitrogen atom containing poly(alkylenepolyamine) and poly(ethyleneimine) flocculants. An aqueous stream of calcium, potassium, or sodium hydroxide is added to the wastewater to adjust the pH from about 9 to 10. Also added to the wastewater is an aqueous stream of an anionic polymeric flocculant. The wastewater stream is passed to a separator to separate the resulting aggregated polymeric material and to provide an essentially clean wastewater stream. (Cremmins-AEPCO)
W88-10100

PROCESS FOR RECOVERING AND RECYCLING COAGULANT PRESENT IN WATER TREATMENT SLUDGES,
Environmental Products, Inc., Boca Raton, FL.
A. R. White.
U. S. Patent No. 4,448,696; May 15, 1984, 13 p, 2 fig, 6 tab, 31 ref. Official Gazette of the United States Patent Office, Vol 1042, No. 3, p 1180, May 15, 1984.

Descriptors: *Patents, *Coagulation, *Waste recovery, *Recycling, *Sludge, *Water treatment, *Acids, Solubility, Filtration, Neutralization, Solid waste disposal, Suspended solids.

Coagulants are recovered and recycled from sludge produced by water treatment processes and containing the base form of the coagulant, acid soluble impurities, and other types of suspended matter. Acid is added to coagulant containing water treatment sludge in an amount sufficient to convert most, but not all, of the hydroxide form of the coagulant potentially recoverable from the sludge to the acid soluble form of the coagulant. A controlled amount of the recovered coagulant filtrate is discarded. Both of these steps combine to stabilize at steady state the quantity of acid soluble impurities present in the recovered coagulant filtrate at an acceptable maximum contaminant level determined for the water treated with the recycled recovered coagulant. After it is filtered to recover the acid soluble form of the coagulant, the acid treated sludge yields a solids cake which is subsequently neutralized and disposed. (Cremmins-AEPCO)
W88-10104

METHOD OF BIOPOLYMERIC SLUDGE DEWATERING,
Miles Labs., Inc., Elhart, IN.
K. H. Chung, G. L. Davis, and F. H. Verhoff.
U.S. Patent No. 4,609,470; September 2, 1986, 5 p, 5 tab, 3 ref. Official Gazette of the United States Patent Office, Vol 1070, No 1, p 277, September 2, 1986.

Descriptors: *Patents, *Wastewater treatment, *Dewatering, *Activated sludge, Flocculation, Industrial wastewater, Municipal wastewater, Separation techniques, Additives, Polymers.

Aqueous sludge, such as sewage sludge, is dewatered by mixing it with an amount of chitosan that effectively flocculates the sludge solids and an amount of an organic dialdehyde that substantially strengthens the solid floc and increases the settling rate. A high degree of solids separation is achieved when sewage sludge is mechanically dewatered following this treatment. The physical properties of the floc can also be improved by adding the dialdehyde to the sludge prior to the addition of the chitosan and by adjusting the pH of the sludge to about 5 to 7 during the flocculation step. The dewatering method provides floc which is substantially stronger in terms of its resistance to resuspension following the application of high shear forces. The floc also separates more readily from the liquid phase than floc obtained by the use of chitosan alone at a natural pH or by the use of a synthetic cationic polymeric flocculant. The solids which remain suspended in the aqueous phase after pretreatment of the sewage sludge, and which are captured in the flocculation step, are primarily organic solids such as bacteria and bacterial residues, cellulosic and proteinaceous material, and the like. (Cremmins-AEPCO)
W88-10108

PROCESS FOR PURIFICATION OF WASTEWATER ACCUMULATED FROM PULP PRODUCTION, PARTICULARLY FROM CHLORINE BLEACHING OF PULP,
D. J. Becker.
U.S. Patent No. 4,490,257; December 25, 1984, 4 p. Official Gazette of the United States Patent Office, Vol 1049, No 4, p 1679, December 25, 1984.

Descriptors: *Patents, *Biological wastewater treatment, *Industrial wastes, *Pulp and paper industry, Activated sludge, Wastewater oxidation, Flocculation, Clarification, Chlorine.

Biological treatment of pulp, paper, and cardboard industrial wastewaters is introduced into an electrolysis installation and subjected to constant movement during an anodic oxidation treatment. An electric potential differential is plotted between the electrodes and the pH of the wastewater is set and maintained at about 1 to 6.5. The treated wastewater is transferred into a flocculation zone, in which an aqueous solution of a powerful cationic polyelectrolyte is fed to it at room temperature and under constant movement and the same range of pH. After the flocculation of colloids and suspended components, the wastewater is transferred with the flocculated products into a third zone, in which the products are separated out. The wastewater is then neutralized and transferred into an activated sludge facility, in which additive nutrients and microorganisms cause biological decomposition of the organic products still present in the wastewater. The clarified wastewater is then discharged into a receiving stream. (Cremmins-AEPCO)
W88-10110

START-UP OF AN UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR FOR TREATING THERMOMECHANICAL PULPING EFFLUENTS,
Tampere Univ. of Technology (Finland).
J. Rintala.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 221-230, 1987. 5 fig, 5 tab, 14 ref.

Descriptors: *Industrial wastes, *Sludge, *Pulp wastes, *Wastewater treatement, *Anaerobic digestion, Sludge cake, Sludge seeding.

The start-up of upflow anaerobic sludge blanket reactors for treating thermomechanical pulping wastewater was studied. Three laboratory -scale reactors were inoculated with different amounts of sludges originating from a conventional anaerobic digester. The effects of a small amount of pulverized peat coke in the seed sludge was examined. The reactor seeded with the highest amount of sludge was most resistant to sludge washout and retained a greater amount of sludge than the other reactors. The addition of peat coke was not found to facilitate the start-up. There were no remarkable differences in specific sludge activities between the three reactors. It was observed that feed interruptions of several hours disturbed the process and delayed the start-up. (Author's abstract)
W88-10124

POSSIBILITIES FOR PURIFICATION OF EFFLUENTS FROM PESTICIDE PRODUCTION USING MAGNETIC TREATMENT AND ELECTROCOAGULATION,
Helsinki Univ. of Technology, Espoo (Finland). Lab. of Environmental Protection Technology.
R. Maatta, and D. Tabakov.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 239-244, 1987. 3 fig, 1 tab, 8 ref.

Descriptors: *Magnetic treatment, *Pesticides, *Electrochemistry, *Coagulation, *Organic wastes, *Wastewater treatment, Sedimentation, Organic pesticides, Effluents, Water purification, Reagents, Zinc, Filtration.

This paper deals with the application of magnetic treatment and electrocoagulation in the treatment of industrial effluents from the production of the pesticide perocin. The use of magnetic treatment and electrocoagulation intensifies the process of coagulation and sedimentation. Different variants of a technological scheme for treatment of industrial effluents have been suggested, specifically mechanical sedimentation, filtration, magnetic treatment, electrocoagulation and reagent purification of zinc. (Friedmann-PTT)
W88-10126

DOWNFLOW FIXED-FILM ANAEROBIC REACTORS STABILITY STUDIES UNDER ORGANIC AND HYDRAULIC OVERLOADING AT DIFFERENT WORKING VOLUME,
University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
M. Canovas-Diaz, and J. A. Howell.
Water Research WATRAG, Vol. 22, No. 5, p 529-536, May 1988. 8 fig, 4 tab, 21 ref.

Descriptors: *Wastewater-treatment, *Anaerobic digestion, *Stability analysis, *Downflow fixed-film anaerobic reactors, *Organic loading, *Hydraulic loading, Biological treatment, Methane bacteria, Flooding, Trickling filters, Subsurface filters, Load distribution, Biofiltration, Organic acids, Inhibition.

Four downflow fixed-film anaerobic reactors were used in this study. The effects of organic and hydraulic overloading on the reactors' performance were studied. Initially, the reactors were operated at different working volumes and fed with a synthetic medium during start-up and after reaching a steady organic loading with deproteinized cheese whey. Reactors operated fully flooded (downflow stationary-fixed-film-DSFF-mode) had higher levels of acetic and butyric acids than reactors operated half flooded (anaerobic trickling filter-ATF-mode) during organic overloading. During hydraulic overloading, propionic and butyric acids rose to much higher levels within DSFF reactors than within ATF reactors. Systems operated in an ATF mode produced slightly higher amounts of methane as well as giving higher conversion at lower hydraulic retention time than DSFF reactors. ATF reactors had a thin though very active biofilm, since biofilm thickness was controlled by shear and gravity forces as well as fluid recycle. In an ATF, inhibition occurred at a maximum of 2000 mg/L of acetic, 3000mg/L of propionic and 400 mg/L of butyric acid after a sharp overloading. (Author's abstract)
W88-10259

PRODUCTION OF LIPOPHILIC VOLATILE ORGANOHALOGEN MATERIALS DURING LABORATORY CHLORINATION OF SOME WASTE WATER AND POLLUTED RIVER WATER SAMPLES FROM YUGOSLAVIA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
V. Hocenski, M. Picer, and N. Picer.
Water Research WATRAG, Vol. 22, No. 5, p 543-552, May 1988. 5 fig, 6 tab, 27 ref.

Descriptors: *Wastewater treatment, *Chlorination, *Lipophilic volatile organohalides, *Chlorinated hydrocarbons, *Pollutants, *Organic matter, Chloroform, Trihalomethanes, Correlation coefficient, Halogens, Organic compounds, Yugoslavia, Chemical reactions.

Water chlorination leads to the generation of various halogenated products of natural and wastewater organic matter. In natural surface water, humic matter usually makes the greatest part of the total organic matter. However, in river water polluted with various organic wastes, other organic matter is also present in significant concentrations. The investigation of the relationship between the concentration of organic matter in the samples of waste water and heavily polluted river waters in Yugoslavia, and the production of lipophilic volatile organohalogen materials during the process of their chlorination is described. The production of halomethanes and other ECD response

materials during the chlorination of water samples in laboratory conditions is compared with the concentrations of organic materials in water samples. From the obtained linear correlation coefficients, possibilities of predicting amounts of organohalides during the chlorination process by using several very simple methods for the organic materials estimation are discussed and compared. (Author's abstract)
W88-10261

NITROGEN TRANSFORMATION IN WASTEWATER RECLAMATION,
Hebrew Univ. of Jerusalem (Israel). Div. of Microbial and Molecular Ecology.
S. Diab, and M. Shilo.
Water Research WATRAG, Vol. 22, No. 5, p 557-563, May 1988. 6 fig, 3 tab, 17 ref.

Descriptors: *Nitrogen cycle, *Wastewater treatment, *Water reuse, *Nitrogen, *Nitrification, *Recharge basins, *Groundwater recharge, Ammonia, Nitrates, Percolation, Accumulation, Adsorption.

Nitrogen transformation was examined in the sequential stages of wastewater treatment in the Dan Region Wastewater Reclamations Project in Israel. It was shown that volatilization, assimilation and nitrification were the mechanisms responsible for ammonia removal from the water during various treatment stages. When the recharge basin dried, nitrification occurred, leading to removal of ammonia and accumulation of nitrate in the sand. Upon flooding the recharge basin, nitrate was leached from the sand and accumulated in the groundwater, while ammonia was adsorbed to particles in the same layers. The denitrification and ammonification processes are limited in the recharge basin, since the organic matter content is very low. The recovery well water will be used for irrigation of agricultural crops, therefore, there is no need to reduce the nitrate load in this water. (Author's abstract)
W88-10263

BIOLOGICAL MECHANISM OF ACETATE UPTAKE MEDIATED BY CARBOHYDRATE CONSUMPTION IN EXCESS PHOSPHORUS REMOVAL SYSTEMS,
Tokyo Univ. (Japan). Dept. of Urban Engineering.
V. Arun, T. Mino, and T. Matsuo.
Water Research WATRAG, Vol. 22, No. 5, p 565-570, May 1988. 2 fig, 5 tab, 13 ref.

Descriptors: *Activated sludge process, *Acetate uptake, *Carbohydrates, *Wastewater treatment, *Phosphorus removal, Anaerobic digestion, Substrates, Aerobic digestion, Biochemistry, Metabolism, Bacterial physiology, Orthophosphates, Wastewater treatment, Bacteria.

The basic mechanism of substrate utilization has yet to be conclusively identified in the anaerobic-aerobic activated sludge process for enhanced phosphorus removal. Various researchers have reported poly-beta-hydroxybutyrate (PHB) production and accumulation by the cell when fed with acetate under anaerobic conditions. Acetate is converted to acetyl-CoA, and the energy required for this conversion is supplied by the hydrolysis of intracellular polyphosphates. Synthesis of PHB from acetyl-CoA does not require ATP, but reducing power as NADH is essential. Some researchers have suggested that circulating some acetyl-CoA through the tri-carbonic acid (TCA) cycle would produce the requisite reducing power, but the TCA cycle is generally believed to accomplish complete oxidation of acetyl-CoA by transport of electrons to terminal electron acceptors like oxygen or nitrates. Therefore, investigation for alternate sources of NADH was undertaken. Four anaerobic batch experiments were conducted with anaerobic-aerobic acclimatized sludge fed with acetate. Samples were analyzed for COD and acetate uptake, P release, CO2 production and for intracellular carbohydrate, protein and PHB content. PHB was synthesized by the sludge corresponding to acetate and COD uptake, along with orthophosphate release. Protein synthesis was not observed but intracellular carbohydrates were consumed. From the results, it is concluded that intracellular carbohydrates are consumed via the Embden-Meyerhoff-Paranas pathway and converted to acetyl-CoA, which provides NADH required for PHB synthesis. As the observed carbohydrate consumption is greater than the theoretical requirement of PHB synthesis, the consequent excess NADH available makes the possibility of some acetyl-CoA being circulated through the TCA cycle very remote. (Author's abstract)
W88-10264

HETEROGENEOUS COAGULATION OF ORGANIC COLLOID AND POWDERED ACTIVATED CARBON,
Tokyo Univ. (Japan). Inst. of Industrial Science.
M. Suzuki, and K. Chihara.
Water Research WATRAG, Vol. 22, No. 5, p 627-633, May 1988. 10 fig, 4 tab, 6 ref. Japanese Ministry of Education Grant in Aid for Scientific Research 57030012.

Descriptors: *Chemical wastewater treatment, *Wastewater treatment, *Coagulation, *Heterogeneous coagulation, *Colloids, *Activated carbon, *Powdered activated carbon, Dissolved solids, Suspended solids, Adsorption, Heat treatment, Neutralization, Surface charge, Temperature.

For the treatment of wastewaters containing both dissolved and suspended organics, powdered activated carbon may well be applied to remove dissolved organics by adsorption and suspended soild organics by heterogeneous coagulation, at the same time. The condition for this heterogeneous coagulation was studied. First, control of surface charge of activated carbon by heat treatment was examined. It was found that it is possible to shift the surface charge of the powdered activated carbon in a positive direction. Secondly, heterogeneous coagulation of organic colloid by heat-treated carbon or carbon black was attempted. Coagulation was successful. Stoichiometry of the coagulation was well explained by charge neutralization using the surface charge density determined by colloid titration. (Author's abstract)
W88-10272

METHANOGENIC BACTERIA ADHERED TO SOLID SUPPORTS,
Gunma Univ., Maebashi (Japan). Faculty of Engineering.
M. Kuroda, M. Yuzawa, Y. Sakakibara, and M. Okamura.
Water Research WATRAG, Vol. 22, No. 5, p 653-656, May 1988. 6 fig, 3 tab, 5 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Biological wastewater treatment, *Bacteria, *Biofilms, Substrates, Adhesion, Bacterial physiology, Biomass, Methanogenic bacteria, Acidogenic bacteria.

Adhesion of methanogenic bacteria and acidogenic bacteria to solid supports was studied by using various solid materials. Three kinds of bacteria slurries were prepared. These were cultured by feeding acetic acid, an acid mixture, and a mixture of glucose and peptone, respectively. Test specimens were submerged into the bacteria slurries for different periods of time. The overall process of biofilm development was divided into three phases: induction, accumulation, and dynamic balance between production and shearing. The quantity of adhered biomass varied with the type of solid support. Bacteria adhered more to moderately rough surfaces with pores measuring a few tenths of a micron in diameter than to polished surfaces without pores. Supports made of carbon were preferred over plastic, ceramic, or stainless steel surfaces. The formation of the biofilm depends not only on the characteristics of the bacteria and fluid regime, but on the characteristics of the solid supports. (Author's abstract)
W88-10277

FILTERING UNIT FOR THE REMOVAL OF PESTICIDE RESIDUES FROM AQUEOUS SOLUTIONS,
Stazione Sperimentale Agraria Forestale, Trento (Italy).
For primary bibliographic entry see Field 5G.
W88-10278

TWO-STAGE ACTIVATED SLUDGE TREATMENT OF AN INTEGRATED KRAFT PULP MILL EFFLUENT,
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
A. Mehner.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 63-71, 1987. 3 fig, 6 tab, 11 ref.

Descriptors: *Kraft mills, *Biological waste water treatment, *Wastewater treatment, *Activated sludge process, *Pulp wastes, *Sludge, Activated sludge, Aeration, Finland, Pulp and paper industry, Pilot plants, Chemical oxygen demand, Biological oxygen demands.

Wastewaters from a bleached kraft pulp, paper and board mill were treated in a two-stage activated sludge plant, where both stages had a separate sludge circulation. Depending on the hydraulic load used, the first stage was either high rate or conventional and the second stage conventional or low loaded. The experiments were carried out in pilot plant scale. Nutrients were added with a minimum ratio of BOD:N:P = 100:3.5:85 and the influent was neutralized. Despite a short total aeration time and high volumetric loads, the removal efficiencies for BOD and CODcr were good. When the total aeration time was 3.8 hours, reduction ion BOD was 73-92% and that in COD, 15-46%. When the total aeration time was raised to 4.8 hours, reductions of 84-96% BOD and 40-69% CODcr were achieved. In the latter case, the volumetric load was 12.7 kg CODcr cu m/d in the first stage and 4.8 kg CODcr cu m/d in the second stage. In spite of the high suspended solids load in the first stage aeration, the sludge production of the biological process was 0.32 kg mixed liquor suspended solids per kg (CODcr)red. (Author's abstract)
W88-10293

APPLICATION OF TIME SERIES ANALYSIS WHEN MODELLING SEWAGE TREATMENT PLANT INPUT DATA,
Soil and Water Ltd., Helsinki (Finland).
R. Laukkanen.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 73-79, 1987. 5 fig, 3 tab, 1 ref.

Descriptors: *Wastewater treatment, *Time series analysis, *Model studies, *Biochemical oxygen demand, *Chemical oxygen demand, *Process control, Box Jenkins method, Finland, Process inputs, Mathematical studies, Flow rates, Forecasting, Phosphorus, Suspended solids.

Reliable short-term forecasts of process inputs are a necessity for efforts to increase treatment efficiency by means of process control. Time series analysis is concerned with serially correlated data where the relations between consecutive observations are of interest. The Box-Jenkins method seeks, from the inspection of the estimated autocorrelation and partial autocorrelation functions obtained from an observed time series, to recognize patterns which could be explained by some model. The residuals of the models derived for the flow rate, biochemical and chemical oxygen demand, total phosphorus and suspended solids are white noise. Models were developed using these five input variables for the case of the Suomenja Treatment Plant, Espoo, Finlands. The models are parsimonious and physically reasonable and they produce reliable forecasts of process inputs. (See also W88-10295) (Author's abstract)
W88-10294

TRANSFER FUNCTION NOISE MODELS IN THE ANALYSIS OF SEWAGE TREATMENT PROCESS INTERRELATIONS,
Soil and Water Ltd., Helsinki (Finland).
R. Laukkanen.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 81-89, 1987. 9 fig, 2 tab, 3 ref.

Descriptors: *Statistical methods, *Autocorrelation, *Variability, *Wastewater treatment, *Time series analysis, *Process control, Effluents, Finland, Noise models, Transfer function, Errors, Biochemical oxygen demand, Suspended solids.

Transfer function noise models are applied to describe the nature and the extent of the variability in effluent quality and to identify factors contributing to this variability. The joint relationship of a dependent variable (effluent biochemical oxygen demand or suspended solids) and an explanatory variable, the between variation, is buried within the variation of a dependent and an explanatory variable, the within variable, and cannot be discovered unless all other types of variation have been eliminated. To eliminate the within variations, both the series of dependent and explanatory variables must be prewhitened. The main target of the study of process dynamics is to achieve a better control of existing plants by transfer function noise models. Data from the Suomenoja Treatment Plant, Espoo, Finland, were used in the analysis. The work demonstratedhow the use of traditional statistical analyses easily give misleading results when the data are autocorrelated time series. The transfer function noise model is on efficient tool for the analysis of process interrelations. (Miller-PTT)
W88-10295

ENVIRONMENTAL PROTECTION IN THE UNITED STATES PULP, PAPER, AND PAPERBOARD INDUSTRY: AN OVERVIEW OF REGULATION OF WASTEWATER UNDER THE U.S. CLEAN WATER ACT,
Environmental Protection Agency, Washington, DC. Office of the Assistant Administrator for Water.
For primary bibliographic entry see Field 5G.
W88-10309

REDUCING THE DISCHARGES TO WATER--TECHNICAL OBJECTIVES,
AF-Industrins Processkonsult A.B., Stockholm (Sweden).
H. A. Norrstrom.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 9-18, 1988. 9 fig, 7 ref.

Descriptors: *Wastewater treatment, *Bleaching wastes, *Chlorination, *Pulp wastes, Pulp and paper industry, Oxygen bleaching, Technology, Optimization, Chlorine, Effluents, Water quality management, Digestion, Aerobic digestion, Lagoons, Aerated lagoons, Wastes, Industrial wastes, Oxygen.

Technologies are reviewed for reducing wastewater discharges from the pulp and paper industry. Oxygen bleaching is in most cases the most efficient first step to reduce the discharge of chlorinated material. With appropriate process design and control, the discharge of chlorinated material will be 3-4 kg/ton. To achieve lower discharge levels, the chlorination stage can be modified by applying lower chlorine charge alone or in combination with chlorine dioxide addition. The present Swedish environmental requirements of about 2 kg/ton necessitate such measures. Careful process optimization is necessary to avoid changes in product quality. Modified cooking can be one way to create the extra flexibility necessary to maintain top quality. To reduce the discharge levels further, new process technology has to be introduced. The Prenox process, membrane filtration of effluents, and partial or complete recycle of bleach effluents are discussed, along with external treatment methods. (Author's abstract)
W88-10310

REQUIREMENTS FOR THE TREATMENT OF EFFLUENTS FROM CHEMICAL PULP MILLS IN THE F.R.G.,
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
L. Huber, and H. Baumung.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 19-24, 1988. 5 tab.

Descriptors: *Wastewater treatment, *Pulp wastes, *Pulp and paper industry, *Chemical wastes, *Germany, *Water quality standards, *Regulations, *Bleaching wastes, Administrative regulations, Wastes, Industrial wastes, Effluents, Evaporation, Incineration, Standards, Biological treatment.

In 1986, the 11 chemical pulp mills in the Federal Republic of Germany produced 350 t of bleached sulfite pulp. With the enactment of the so-called minimum requirements in 1982, general standards for the treatment of effluents were promulgated for this branch of industry. They comprise various measures, such as high-grade recovery of spent liquor, including its evaporation and incineration, partial or total reuse of condensates from evaporation or reduction of their load by stripping, and mechanical treatment of total wastewater. In view of the persisting high pollution levels of German rivers caused by pulp mills, more stringent standards reflecting the present state of the art will be implemented in 1991. These standards are reviewed, covering the applicable in-plant and external abatement measures, such as extended cooking, substitution of elemental chlorine, and biological treatment for decisive improvement of the chemical pulp mill effluent situation. (Author's abstract)
W88-10311

DEVELOPMENT OF WASTE WATER TREATMENT IN THE FINNISH PULP AND PAPER INDUSTRY,
Tampere Univ. of Technology (Finland).
A. Luonsi, J. Junna, and I. Nevalainen.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 25-36, 1988. 9 fig, 2 tab, 14 ref.

Descriptors: *Finland, *Pulp and paper industry, *Wastewater treatment, *Activated sludge process, *Water quality standards, *Pulp wastes, Technology, Oxygen demand, Biological oxygen demand, Sludge, Activated sludge, Nutrients, Eutrophication, Phosphorus, Reviews, Biological treatment, Anaerobic digestion, Digestion, Biodegradation, Standards, Wastes, Industrial wastes.

Recent developments in wastewater treatment in Finland's pulp and paper industry are reviewed. Topics discussed include the role of the pulp and paper industry in water pollution in Finland, mechanical treatment, aerated lagoons, aerobic biofilters, activated sludge plants, and anaerobic reactors. Thirteen activated sludge plants and one anaerobic reactor have been constructed during the last four years, reducing the biological oxygen demand of the wastewater. Target values set for suspended solids and biological oxygen demand for 1985 are expected to be achieved during 1987. Activated sludge plants create potential problems of large amounts of surplus biological sludge and increased nutrient discharges, especially phosphorus, increasing the eutrophication of discharge areas. However, nutrient discharge is not increased when plants are operated properly. The problem of wastewater treatment is complex, since any substance removed from wastewater will be found either in the sludge or in the air. Future standards and current research are discussed. (Doria-PTT)
W88-10312

WATER POLLUTION ABATEMENT IN SMALL PAPER MILLS IN INDIA,
National Productivity Council, New Delhi (India).
L. Panneerselvam.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 37-48, 1988. 2 fig, 5 tab, 5 ref.

Descriptors: *India, *Pulp and paper industry, *Pulp wastes, *Wastewater treatment, *Water pollution control, *Water quality standards, Wastes, Industrial wastes, Water pollution, Silica, Oxygen demand, Biological oxygen demand, Standards, Costs, Operating costs, Economic aspects, Case studies, Cost analysis.

Water pollution by small paper mills in India and its abatement are discussed. In order to conserve forest resources, the government of India is promoting small-scale pulp and paper mills using nonwood agricultural residues as raw materials. However, while the quantity of wastewater generated per ton of paper produced by a small mill is the same as from a large integrated pulp and paper mill with a chemical recovery system, the biological oxygen demand load of a small mill is four times higher because of non-recovery of chemicals. It is not economically feasible for small mills to recover the chemicals because of high silica content and other characteristics of the black liquor and the subsequent large capital investment needed for a recovery system. A feasible alternative is to implement various pollution abatement measures, with the objective not only of reducing the fiber/chemical loss but also to reduce the investment and operating costs of the final wastewater treatment system. A case study on water pollution control in a 10-ton-per-day mill is presented. (Author's abstract)
W88-10313

PRACTICAL EXPERIENCES IN ACTIVATED SLUDGE TREATMENT WITHIN THE METSA-SERLA GROUP,
J. Kettunen.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 61-64, 1988. 1 fig.

Descriptors: *Activated sludge process, *Wastewater treatment, *Biological treatment, *Waste disposal, *Pulp and paper industry, *Pulp wastes, Sludge, Activated sludge, Oxygen demand, Biological oxygen demand, Technology, Finland, Phosphorus, Reviews, Finland, Cost analysis, Economic aspects, Performance evaluation, Wastes, Industrial wastes.

The wastewater treatment experiences of a single forest industry company in Finland using the activated sludge system are discussed. The Metsa-Serla group produces a variety of pulps and operates five activated sludge plants. Process control, sludge treatment and disposal, planning, and toxicity of mill wastewater are described. Operating costs depend on the mill production process and the size of the operation. It is concluded that activated sludge treatment is a good possibility for the treatment of forest industry wastewaters if the key problem is to decrease the oxygen consumption of the effluent. The successful use of this technology requires that the water economy of the mill meet modern standards. (Doria-PTT)
W88-10315

EFFICIENCY OF A BIOLOGICAL ACTIVATED SLUDGE EFFLUENT TREATMENT PLANT WITH EXTENDED AERATION,
Schauman (W.) Oy A.B., Jakobstad (Finland).
R. Skogman, and R. Lammi.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 65-72, 1988. 3 fig, 6 tab.

Descriptors: *Water pollution control, *Wastewater treatment, *Biological treatment, *Pulp wastes, *Activated sludge process, Aeration, Pulp and paper industry, Cost analysis, Sludge, Activated sludge, Finland, Wastes, Industrial wastes, Effluents, Costs, Capital costs, Operating costs, Labor costs, Maintenance costs, Economic aspects.

The Wilh. Schauman Company in Jakobstad, Finland has chosen activated sludge with extended aeration from among the available methods for treating pulp mill effluent. The design, operation, characteristics, and economics of the system are discussed. The plant has operated since the beginning of 1986 with good results. Besides the reduction of biological oxygen demand and suspended solids, there has been a marked decrease of chlorinated phenols. Chlorinated substances with higher molecular weights are also removed during the process. It is concluded that a plant of this type can be a significant argument in future discussions on restrictions of various compounds released from a pulp mill with bleaching plant. (Author's abstract)
W88-10316

PARTITIONING OF ORGANIC CHLORINE BETWEEN BULK WATER AND BENTHAL IN-

TERSTITIAL WATER THROUGH A KRAFT MILL AERATED LAGOON,
Arizona Univ., Tucson. Dept. of Civil Engineering.
C. W. Bryant, G. L. Amy, R. Neill, and S. Ahmad.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 73-79, 1988. 3 tab, 10 ref.

Descriptors: *Wastewater treatment, *Pulp wastes, *Benthic environment, *Organic compounds, *Chlorinated hydrocarbons, Interstitial water, *Aerated lagoons, Fate of pollutants, Bleaching wastes, Environment, Mills, Hydrocarbons, Biotransformation, Bioaccumulation, Accumulation, Wastes, Industrial wastes, Biochemical oxygen demand, Organic compounds, Chlorine, Kraft mills, Pulp and paper industry, Lagoons, Bleaching wastes.

A study was undertaken to delineate the partitioning of organic chlorine between benthal solids and interstitial water, and to compare organic chlorine levels in interstitial versus overlying water, during treatment of kraft mill wastewater in an aerated lagoon. Organic chlorine was measured as the non-purgeable fraction of organic halide. While the lagoon was very effective in removing biochemical oxygen demand and suspended solids, it was capable of removing only approximately one-third of the total organic halide. Significantly lower liquid phase total organic halide and total organic carbon concentrations were found in core water as opposed to overlying water samples. This result, coupled with lower values of the ratio of total organic halide to total organic carbon for core waters, indicates that significant dehalogenation and organic carbon degradation occurs within the anoxic benthal zone. Biosorption plays a significant role in transporting total organic halide compounds from the water column to the benthal layer. (Doria-PTT)
W88-10317

CONTROL OF THE PHOSPHORUS LEVEL OF EFFLUENT IN THE TREATMENT OF FOREST INDUSTRY WASTE WATERS,
Soil and Water Ltd., Helsinki (Finland).
P. Vaananen.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 81-86, 1988. 6 tab, 5 ref.

Descriptors: *Pulp and paper industry, *Phosphorus, *Pulp wastes, *Wastewater treatment, *Activated sludge process, *Nutrient removal, Wastes, Industrial wastes, Tertiary wastewater treatment, Sludge, Activated sludge, Oxygen demand, Biological oxygen demand, Eutrophication, Finland, Effluents, Precipitation, Sulfates, Chemical treatment.

The phosphorus load from wastewater treatment plants in Finland has decreased since 1970. The construction of activated sludge plants for the treatment of forest industry wastewaters will drastically reduce the biological oxygen demand level, but may substantially increase the phosphorus load. Possible treatment methods are discussed based on pilot and full-scale experiments in two kraft pulp mills. Chemical treatment using simultaneous precipitation by ferrous sulfate is studied in detail. It is concluded that phosphorus concentration can be reduced to a level of 1.2 mg/l cost-effectively by adding ferrous sulfate to the aeration basin. Ferrous sulfate also has a slight positive effect on such sludge properties as settleability. Improvement is also possible in the conventional activated sludge process by automation of nutrient feed. (Doria-PTT)
W88-10318

SITE HIGH RATE UASB ANAEROBIC DEMONSTRATION PLANT TREATMENT OF NSSC WASTEWATER,
Paques B.V., Balk (Netherlands).
L. H. A. Habets, M. H. Tielbaard, A. M. D. Ferguson, C. F. Prong, and A. J. Chmelauskas.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 87-97, 1988. 5 fig, 3 tab, 9 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Pulp and paper industry, *Wastewater facilities, *Sludge, *Pulp wastes, Cost analysis, Wastes, Industrial wastes, Industrial plants, Mills, Effluents, Optimization, Pilot plants, Technology, Performance evaluation, Costs, Capital costs, Operating costs, Digestion.

Laboratory scale and pilot plant studies were performed on the suitability of upflow anaerobic sludge blanket (UASB) technology for treating pulp mill effluent. On-site demonstration studies were conducted at the automated MacMillan Bloedel pilot plant at Burlington, Ontario to confirm wastewater treatability, optimize design loading rates, and confirm granular sludge growth. Start-up performance results and operation at incremental loadings under steady state conditions are presented, together with the experience gained during extreme variations in mill effluent quality and flow. Preliminary results disclose that a biological oxygen demand removal efficiency of 80% or more is achieved at weekly average loadings of 15 kg COD/cu m/day, and the process is resilient to daily swings in wastewater quality. Results show a net accumulation of granular sludge. The practical application of this technology from a mill operating perspective is discussed, and the layout for a full-scale installation with projected capital and operating costs is provided. (Author's abstract)
W88-10319

TAMAN PROCESS: EXPERIENCES OF FULL-SCALE OPERATION AT ANJALA PAPER MILL,
Tampella Oy A.B., Tampere (Finland).
M. Lehtomaki.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 99-105, 1988. 5 fig, 5 tab, 2 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Pulp and paper industry, *Wastewater facilities, *Sludge dewatering, *Fluidized process, *Pulp wastes, Digestion, Mills, Wastes, Industrial wastes, Industrial plants, Oxygen demand, Biological oxygen demand, Clarification, Finland, Water use, Sludge, Sludge drying, Incineration.

The first full-scale anaerobic wastewater treatment plant in the Finnish wood processing industry has been completed at Anjala Paper Mill. This TAMAN process together with the extensive renewal of the water circulation systems as well as solids recovery have made it possible to meet the new environmental requirements coming into force in June, 1987. The total BOD7 reduction due to this program is nearly 90%. The wastewater flow through the TAMAN process is 11,000 cu m/day. The specific water consumption of the debarking plant has been minimized, and circulation water is clarified in a separate settler. TAMDEC gravity thickeners make solids retention more effective, and the TASSTER screw press ensures that all the mill's sludge is dewatered before fluidized bed incineration. (Author's abstract)
W88-10320

SEQUENTIAL ANAEROBIC AND AEROBIC TREATMENT OF KRAFT PULPING WASTES,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. Qiu, J. F. Ferguson, and M. M. Benjamin.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 107-120, 1988. 11 fig, 6 tab, 11 ref.

Descriptors: *Anaerobic digestion, *Aerobic digestion, *Pulp wastes, *Wastewater treatment, *Kraft mills, *Bleaching wastes, Digestion, Pulp and paper industry, Mills, Industrial plants, Industrial wastes, Wastes, Sulfur, Nutrient removal, Carbon, Organic carbon, Chlorine, Oxygen demand, Chemical oxygen demand, Biological oxygen demand, Suspended solids.

A study of sequential anaerobic and aerobic treatment was conducted with combinations of kraft evaporator condensate (KEC) and caustic extraction (CE) stage bleaching effluent. In addition to conventional measures of treatment efficiency, the transformations and removal of sulfur compounds from the KEC and changes in molecular size fraction of organic carbon and organic chlorine were measured. A large fraction of the BOD in the combined waste could be removed in the anaerobic stage at loadings of up to at least 15 kg COD/cu m/day. The overall process produced an effluent with < 30 mg/l BOD and suspended solids with varying amounts of COD, depending on the CE fraction being treated. Fractional removals of organic carbon and COD were approximately equal and were significantly greater than that of organic chlorine. Removal efficiencies were higher for the low molecular weight fraction. One third of the influent sulfur was removed as H2S gas in the anaerobic stage. The remaining sulfur was largely oxidized to sulfate in the aerobic stage, with nearly complete elimination of odors. (Author's abstract)
W88-10321

IMPROVEMENT OF COD ELIMINATION IN ACTIVATED SLUDGE TREATMENT PLANT FOR PULP AND PAPER MILL WASTE WATERS,
Papiertechnische Stiftung fuer Forschung und Ausbildung in Papiererzeugung und -Verarbeitung, Munich (Germany, F.R.). Wasser- und Abwasserforschungsstelle.
C. H. Moebius.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 121-132, 1988. 17 fig, 1 tab, 7 ref. Arbeitsgemeinschaft Industrieller Forschungsvereinigungen e.V. (AIF) Research Project 5876.

Descriptors: *Wastewater treatment, *Biological treatment, *Chemical oxygen demand, *Activated sludge process, *Pulp wastes, Sludge, Pulp and paper industry, Activated sludge, Oxygen demand, Biodegradation, Effluents, Standards, Water quality standards, Optimization, Cost analysis, Digestion, Aerobic digestion, Anaerobic digestion, Sludge, Retention time.

In recent years, authorities have issued more stringent chemical oxygen demand (COD) regulations for industrial effluents in addition to biological oxygen demand (BOD) limitations. Optimization of operation in the activated sludge treatment plant can be an effective way to meet those regulations without increasing treatment cost. A well dimensioned aerobic or anaerobic plus aerobic treatment plant for pulp or paper mill wastewaters is capable of reducing BOD effluent concentrations to values below 25 mg/l. If the aerobic plant is just big enough to meet this limit, COD elimination will be found to be in a certain ratio to BOD elimination, which has become well known in recent years. If this COD elimination is not sufficient to meet official requirements for COD concentration in the effluent, improvement of COD elimination by optimizing the operating conditions of the activated sludge plant may be possible. Lowering BOD sludge loading and increasing hydraulic retention time to more than 8 hours generally are the ways to do this. Concentration of dissolved oxygen has no effect on COD elimination above 1 mg/l. The best COD elimination can be obtained in optimized aeration cascade reactors and two stage aeration reactors. (Author's abstract)
W88-10322

ANAEROBIC TREATMENT OF SULPHUR-CONTAINING EFFLUENTS,
Centre Technique de l'Industrie des Papiers Cartons et Cellulose, Grenoble (France).
M. Pichon, J. Rouger, and E. Junet.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 133-141, 1988. 6 fig, 5 tab, 12 ref.

Descriptors: *Sulfur, *Anaerobic digestion, *Wastewater treatment, *Biological treatment, *Pulp wastes, Effluents, Digestion, Wastes,strial wastes, Cost analysis, Sulfites, Bacteria, Biodegradation, Pilotts, Pulp and paper industry, Oxygen demand, Chemical oxygen demand, Biological oxygen demand.

A new method of defibering wood chips and producing chemi-thermomechanical pulp (CTMP) with significant capital and energy savings has been developed. The pollution load of bleached CTMP effluent varied between 40-60 kg/t for BOD5 and 120-210 kg/t for COD. The process includes a sulfite stage, and the effluent contains

sulfur compounds that are toxic to methanogenic bacteria. Studies were conducted on anaerobic fixed bed reactors with upflow or downflow feed modes. It is necessary to progressively acclimate bacteria to increasing concentrations of sulfur compounds. Permanent functioning of reactors is possible with COD/S ratios near 10-12 where propionate concentrations are increasing. Upflow reactors are more efficient than downflow reactors, with a maximum loading rate of 3.5 kg COD/cu m/day corresponding to 800 mg/l as S. With hybrid sludge bed/fixed bed reactors, it is possible to enhance anaerobic treatment efficiency. A COD loading rate of 4.7 kg/cu m/day can be maintained with a residence time of 2 days and a pollution load removal efficiency of 45% for COD (55% with complementary oxidation) and 70% for BOD5. The economics of effluent treatment give an investment cost of about $20/ADt for the activated sludge process and $12.50/ADt for anaerobic fixed bed treatment. (Author's abstract)
W88-10323

ANAEROBIC PROCESS FOR TREATMENT OF CTMP EFFLUENT,
Lund Univ. (Sweden). Dept. of Applied Microbiology.
T. Welander.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 143-147, 1988. 2 fig, 5 ref.

Descriptors: *Pulp and paper industry, *Pulp wastes, *Wastewater treatment, *Biological treatment, *Anaerobic digestion, Wastes, Industrial wastes, Digestion, Oxygen demand, Biological oxygen demand, Chemical oxygen demand, Aluminum, Iron, Calcium, Bacteria, Methane bacteria, Sewage bacteria, Fatty acids, Effluents, Biomass, Enzymes, Odor control.

A multi-stage process for treatment of chemi-thermomechanical pulp (CTMP) effluent has been developed, consisting of primary settling and four biological stages. The concentration of hydrogen peroxide, a compound toxic to anaerobic bacteria, is reduced in the first biological stage by means of the biocatalytic action of biomass that is recycled from the following acidogenic and/or aerobic stages. The second stage is an acidogenic stage, in which volatile fatty acids are formed and remaining peroxide is decomposed. A mixture of aluminum, iron, and calcium salts is added to the effluent in order to detoxify compounds which are toxic to methanogenic bacteria. The main part of the COD and BOD removal takes place in the third stage, the methanogenic stage, after which follows an aerobic stage for odor removal. The COD and BOD7 removals in the anaerobic part of the process are 60 and 90%, respectively, and the methane yield is 0.20-0.25 N cubic meters/kg COD removed. (Author's abstract)
W88-10324

TREATABILITY STUDIES AND TOXICITY REDUCTION IN PULP AND PAPER MILL EFFLUENTS,
RIPASA S.A., Sao Paulo (Brazil).
J. B. Galvao, V. M. Grieco, R. P. A. Araujo, M. R. Ortolano, and E. Bertoletti.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 149-160, 1988. 5 fig, 7 tab, 40 ref.

Descriptors: *Toxicity, *Pulp wastes, *Pulp and paper industry, *Wastewater treatment, *Biological treatment, Fish, Daphnia, Mills, Wastes, Bioassay, Industrial wastes, Industrial plants, Effluents, Biodegradation, Performance evaluation, Comparison studies, Crustaceans, Oxygen demand, Chemical oxygen demand, Biological oxygen demand, Pilot plants, Water pollution effects, Indicators, Bioindicators.

A study of the liquid effluents of various production process stages and of the final effluent of the RIPASA S/A Celulose e Papel plant, by means of conventional parameters and toxicity, was undertaken. Using these parameters, the performances of the current treatment system (an aerated pond) and of pilot-scale experimental systems (using aerobic biological processes with one or two stages) were compared. The two-stage system yields better results in the improvement of final effluent quality. Biological degradation rates were also determined. It is thought that these discharges will not have an impact on the receiving water, as far as toxicity is concerned. (Author's abstract)
W88-10325

REMOVAL OF CHLOROPHENOLS AND CHLOROLIGNINS FROM BLEACHING EFFLUENT BY COMBINED CHEMICAL AND BIOLOGICAL TREATMENT,
Goettingen Univ. (Germany, F.R.). Forstbotanisches Inst.
O. Milstein, A. Haars, A. Majcherczyk, J. Trojanowski, and D. Tautz.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 161-170, 1988. 4 fig, 6 tab, 24 ref. Bundesministerium fuer Forschung und Technologie Grant 02-WA 382.

Descriptors: *Phenols, *Lignins, *Chlorinated hydrocarbons, *Bleaching wastes, *Chemical treatment, *Biological treatment, *Wastewater treatment, *Pulp and paper industry, Wastes, Industrial wastes, Effluents, Organic matter, Chlorination, Pilot plants, Hydrocarbons, Color, Organoleptic properties, Oxygen demand, Chemical oxygen demand, Biological oxygen demand, Toxicity, Fish, Enzymes, Fungi, Degradation, Biodegradation.

Organic matter from spent bleaching effluents (from chlorination (C) or extraction (E) stages, or a mixture of both) was precipitated as a water insoluble complex with polyethyleneimine (polyimine). Precipitation was performed in a pilot unit operating automatically. The color, chemical oxygen demand (COD), and adsorbable organic halogens (AOX) were reduced in the C-effluent by up to 92%, 65%, and 84%, respectively. Regarding the E-stage effluent, reduction was up to 76% for color, 70% for COD, and 73% for AOX. No significant reduction of BOD5 was observed in the supernatant of the treated effluent. Fish toxicity was greatly reduced. Laccase increased the molecular weight of the effluent constituents, thus facilitating subsequent precipitation. After treatment with laccase, the bulk of mono- and dichlorophenol is coprecipitated with the liquors from the C and E bleaching stages. Fungi (representatives of the genera Aspergillus and Penicillium) achieved an appreciable level of degradation of chlorophenols and other chlororganic compounds from the bleaching effluent. (Author's abstract)
W88-10326

NEW IDEAS ON POLLUTION CONTROL IN THE PULP AND PAPER INDUSTRY--ARE THERE ANY,
Confederation of Finnish Industries, Helsinki.
For primary bibliographic entry see Field 5G.
W88-10331

RECENT DEVELOPMENTS IN PROCESS AND REACTOR DESIGN FOR ANAEROBIC WASTEWATER TREATMENT,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie.
A. Aivasidis, and C. Wandrey.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 211-218, 1988. 5 fig, 6 tab, 9 ref.

Descriptors: *Anaerobic digestion, *Bleaching wastes, *Wastewater facilities, *Pulp wastes, *Wastewater treatment, *Biological treatment, Wastes, Industrial wastes, Biomass, Carbon, Sulfites, Oxygen demand, Chemical oxygen demand, Digestion, Microbial degradation, Pilot plants, Design criteria, Degradation, Pulp and paper industry, Biodegradation.

Experiments on anaerobic treatment of sulfite evaporator condensate from pulp mills were carried out for the optimization of anaerobic wastewater treatment, using immobilized microorganisms in a 12-liter fixed-bed looped reactor. Porous sintered glass with a porosity of about 50% and a mean pore diameter of 60-100 microns served as the medium. The reactor was operated for several months under steady-state conditions at different residence times. At a residence time of 11 h, 84% of the chemical oxygen demand was removed at loading rates up to 100 kg COD/cu m/day. Optimization of porosity and pore size distribution brought about a further improvement in the volume time yield of biogas. Removal rates up to 160 kg COD/cu m/day could be obtained using reticulated sintered glass with a porosity of 60% and a pore size distribution of 60-300 microns. Experiments are currently being carried out in a pilot plant (reactor volume 1.0 cu m) to obtain data for scaling up and calculating the economic viability of the process. (Author's abstract)
W88-10332

METHANOGENIC TOXICITY OF BARK TANNINS AND THE ANAEROBIC BIODEGRADABILITY OF WATER SOLUBLE BARK MATTER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
J. A. Field, M. J. H. Leyendeckers, R. Sierra Alvarez, G. Lettinga, and L. H. A. Habets.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 219-240, 1988. 12 fig, 13 tab, 47 ref.

Descriptors: *Pulp and paper industry, *Pulp wastes, *Wastewater treatment, *Wood wastes, *Methane bacteria, *Biological treatment, *Biodegradation, *Anaerobic digestion, *Tannins, *Toxicity, Wastes, Industrial wastes, Digestion, Oxygen demand, Chemical oxygen demand, Phenols, Trees, Pine trees, Birch trees, Assays, Bioassays, Chromatography, Gas chromatography, Acidity.

A study was conducted to determine the fermentable chemical oxygen demand (COD) substrate of bark soluble matter in forest industry wastewaters and to determine if the bark tannins are responsible for the previously observed methanogenic toxicity. The principal methanogenic toxins were identified as tannins, which account for about half of the aqueous extractable COD of tree bark. The 50% inhibitory concentration of bark tannins average approximately 600 mg COD/l. The toxicity caused by the resin fraction of bark was found not to be important to the toxicity of aqueous extracts, due in part to poor solubility at the low pH of aqueous extraction. Anaerobic biodegradability results indicated that 30% to 50% of the bark water-soluble COD can be acidified to methanogenic substrates during short-term digestion. Pine and birch bark water-soluble COD acidified up to 70% after long-term batch digestion of 7 weeks. The high level of bark aqueous extract UV absorbance elimination by anaerobic digestion and the appearance of intermediates indicated that at least some of the bark phenolic compounds were included in the methanogenic substrate. (Doria-PTT)
W88-10333

PROCESS ALTERNATIVES FOR ENHANCED BIOLOGICAL TREATMENT EFFICIENCY OF FOREST INDUSTRY EFFLUENTS,
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
A. Mehner, H. Morange, J. Rintala, R. Silvo, and M. Viitasaari.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 241-250, 1988. 3 fig, 6 tab, 7 ref.

Descriptors: *Wastewater treatment, *Biological treatment, *Pulp and paper industry, *Activated sludge process, *Anaerobic digestion, *Aerobic treatment, Finland, Sludge, Activated sludge, Legal aspects, Digestion, Effluents, Phosphorus, Sedimentation, Performance evaluation, Technology.

The advantages and disadvantages of some biological process units completing activated sludge treatment plants in the forest products industry are studied. In experimental studies a, b, and c, a two-stage activated sludge process, a modified activated sludge process, and an anaerobic pretreatment, respectively, were examined. The results of these studies show that a selective, highly loaded first stage of a two-stage activated sludge process can efficiently equalize and improve effluent quality, especially when the suspended solids concentration

in the influent is high (Study a), that an anoxic/anaerobic unit together with a small aerated contact unit combined with a conventional activated sludge process can reduce phosphorus levels in the effluent (Study b), and that anaerobic pretreatment of concentrated wastewaters efficiently reduces the organic loading, improves sludge settling properties, and reduces sludge yield and phosphorus demand (Study c). (Author's abstract)
W88-10334

USE OF ENZYMES FOR WASTEWATER TREATMENT IN THE PULP AND PAPER INDUSTRY--A NEW POSSIBILITY,
Alko Oy A.B., Helsinki (Finland).
R. Hakulinen.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 251-262, 1988. 9 fig, 8 tab, 18 ref.

Descriptors: *Enzymes, *Pulp and paper industry, *Wastewater treatment, *Biological treatment, Color, Organoleptic properties, Biodegradation, Degradation, Microbial degradation.

The use of enzymes and the products of genetic engineering for wastewater treatment in the pulp and paper industry is discussed. The most important enzymes include ligninase, cellulase, lysozymes, laccase, and especially peroxidase, used for color removal in bleaching effluents. Enzymes can also be mixed with special microbes that normally do not have high enzyme activity, to remove recalcitrant and harmless compounds from wastewater. It is concluded that the use of enzymes might be economical, with modern technology producing special tailor-made enzymes for different purposes. More basic research is needed on the behavior of organisms and new biological processes must be developed. (Doria-PTT)
W88-10335

DETERMINATION OF INHIBITING AND TOXIC CONCENTRATIONS OF PAPER AUXILIARY AGENTS,
Hanover Univ. (Germany, F.R.).
H. Ruffer, and H.-J. Boeck.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 269-270, 1988. 1 fig.

Descriptors: *Toxicity, *Inhibition, *Methane bacteria, *Wastewater treatment, *Biological wastewater treatment, *Pulp wastes, Pulp and paper industry, Bacteria, Anaerobic bacteria, Wastes, Industrial wastes, Sludge, Bulking sludge.

Paper auxiliary agents used in paper production can have an inhibiting or toxic effect on microorganisms in wastewater treatment plants. The toxic concentrations of these compounds to methane bacteria were examined in the laboratory. Three classes of anti-foaming agents, six classes of sizing agents, and three classes of retention agents caused little or no inhibition, although there was a danger of sludge bulking. Two classes of wet-strength agents caused obvious inhibition. Slimicides, which were examined very closely, caused strong inhibition which usually decreased only slowly (after 30 h). Three classes of cleaners also had a strong inhibitory effect. Effects vary depending on time and the type of pre-treatment (temperature, pH, aerobic/anaerobic conditions) and sludge concentrations. (Doria-PTT)
W88-10336

METABOLISM OF RESIN ACIDS IN ANAEROBIC SYSTEMS,
New Zealand Forest Service, Rotorua. Forest Research Inst.
P. N. McFarlane, and T. A. Clark.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 273-276, 1988. 5 fig, 3 tab, 1 ref.

Descriptors: *Resins, *Wastewater treatment, *Biological wastewater treatment, *Pulp wastes, *Anaerobic treatment, *Metabolism, *Fatty acids, Degradation, Biodegradation, Digestion, Anaerobic digestion, Fate of pollutants, Accumulation, Chromatography, Gas chromatography, Biomass, Sludge, Wastes, Industrial wastes.

The fate of resin acids during anaerobic treatment of wood processing wastewaters was studied. Upflow anaerobic sludge blanket (UASB) reactor studies were conducted using an authentic wastewater to assess the degradation and accumulation of resin acids within the reactor. Completely-mixed stirred tank reactor studies (CSTR) were conducted using a synthetic wastewater to determine whether cometabolism was important for resin acid degradation. Resin and fatty acid removals from the UASB reactor were quantified by analysis of the screw press wastewater and the soluble UASB effluent. Compounds were identified using gas chromatography/mass spectrometry. In the CSTR, the methanogenic consortium metabolized abietic acid with galactose as a supplementary carbon source. It is concluded that (1) in the presence of readily degradable carbon substrates, all resin acids tested, except dehydroabietic acid, underwent biodegradation; (2) degradation of abietic acid was cometabolic, and no significant degradation of dehydroabietic acid was observed; and (3) methanogenic consortia may acclimatize to supersaturated concentrations of dehydroabietic acid. (Doria-PTT)
W88-10337

ANAEROBIC TREATMENT OF A MIXTURE OF CONDENSATE AND CAUSTIC EXTRACTION LIQUOR FROM A DISSOLVING PULP MILL,
AC Biotechnics A.B., Lund (Sweden).
E. Sarner.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 279-281, 1988. 2 fig, 3 ref.

Descriptors: *Pulp wastes, *Wastewater treatment, *Biological wastewater treatment, *Bases, *Anaerobic digestion, *Pulp and paper industry, Wastes, Industrial wastes, Digestion, Toxicity, Mills, Paper mills, Industrial plants, Pilot plants, Oxygen demand, Chemical oxygen demand, Biological oxygen demand, Sludge, Activated sludge, Bleaching wastes.

A mixture of condensate and caustic extraction liquor from a dissolving pulp mill was treated anaerobically in a pilot plant. The results showed that caustic extraction liquor could be used for pH control, and thus no chemicals were needed for this purpose. No toxic effects could be seen if the flow of caustic extraction liquor was kept in the range of 25-30% of the total flow. The anaerobic COD reduction averaged about 50% and the corresponding BOD reduction varied in the range of 70-80%. (Author's abstract)
W88-10338

IMPROVING THE SETTLING OF ACTIVATED SLUDGE BY CHEMICAL ADDITIVES,
Papiertechnische Stiftung fuer Forschung und Ausbildung in Papiererzeugung und -Verarbeitung, Munich (Germany, F.R.). Wasser- und Abwasserforschungsstelle.
I. Demel, and C. H. Mobius.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 283-286, 1988. 4 fig, 4 ref.

Descriptors: *Sedimentation, *Activated sludge, *Chemical precipitation, *Settling tanks, *Wastewater treatment, *Biological wastewater treatment, *Pulp wastes, Sludge, Bulking sludge, Activated sludge process, Lime, Soil types, Bentonite, Flocculation, Degradation, Biodegradation, Wastes, Industrial wastes.

One of the main problems encountered in biological wastewater treatment plant of paper mills is poor settling of activated sludge in secondary sedimentation tanks. In many cases, activated sludge volume indices stay above 150 ml/g. Moreover, bulking of sludges in activated sludge plants of paper mills is more frequent than usual. Bulking sludge is characterized by excessive growth of filamentous microorganisms. In a lab-scale activated sludge plant, tests were made to improve the settling of activated sludge by adding the following chemicals: lime, alkaline activated bentonite, powdered lignite coke, polyelectrolytes used as flocculants. The findings reveal that dosage of the above additives actually gives improved sedimentation. Moreover, biochemical degradation becomes more effective if bentonite and powdered lignite coke are added. Test results are evaluated to determine the extent to which settling of the activated sludge and plant efficiency are improved, taking into account operational and wastewater parameters. Using lime, bentonite, lignite coke, or polyelectrolytes is an economical method of fighting or preventing acute or permanent problems caused by bulking sludge and high sludge volume indices. (Author's abstract)
W88-10339

CONTROL OF ACTIVATED SLUDGE CIRCULATION AND OF SECONDARY SETTLING TANK HYDRAULICS,
Papiertechnische Stiftung fuer Forschung und Ausbildung in Papiererzeugung und -Verarbeitung, Munich (Germany, F.R.). Wasser- und Abwasserforschungsstelle.
R. Huster, and C. H. Mobius.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 287-290, 1988. 3 fig, 6 ref.

Descriptors: *Activated sludge process, *Settling tanks, *Wastewater treatment, *Biological wastewater treatment, *Process control, *Pulp wastes, Sludge, Activated sludge, Hydraulics, Regulations, Administrative regulations, Effluents, Pilot plants, Industrial plants, Mills, Paper mills, Wastes, Industrial wastes, Sludge volume index, Pulp and paper industry.

The directives issued by the German Wastewater Association (ATV) and by the British Water Research Centre (WRC) with respect to the rating and control of activated sludge circuits and of the loading of secondary settling tanks of biological wastewater treatment plants were studied for their applicability to paper mill effluents. Several years' testing was carried out on an activated sludge pilot plant and on various industrial plants. These tests revealed that secondary settling tanks of paper mill effluent treatment plants may safely be rated in accordance with ATV up to a sludge volume index (SVI) of 300 ml/g and a sludge return rate of 3. If SVI values are low, the WRC process permits excessive surface loadings and is thus only practicable for high SVI levels. If sedimentation properties of the activated sludge are poor, load capacity limits are indicated more correctly by the WRC method. A simplified settling velocity method derived from the WRC process gives reliable information on the load capacity of secondary settling tanks and may readily be used for sludge circulation control. (Author's abstract)
W88-10340

PRACTICAL DESIGN MODEL FOR CALCULATING BUBBLE DIFFUSER CONTACTOR OZONE TRANSFER EFFICIENCY,
Process Applications, Inc., Fort Collins, CO.
K. L. Rakness, R. C. Renner, B. A. Hegg, and A. G. Hill.
Ozone: Science and Engineering OZSEDS, Vol. 10, No. 2, p 173-214, Spring, 1988. 14 fig, 2 tab, 12 ref.

Descriptors: *Ozonation, *Disinfection, *Wastewater treatment, *Wastewater facilities, *Bubbles, *Design criteria, *Model studies, Ozone, Engineering, Case studies, Water treatment facilities, Water quality management, Detention times, Temperature, Hydrogen ion concentration.

A design model that addresses all factors affecting ozone transfer was used to compare measured transfer efficiency with predicted transfer efficiency at four full-scale wastewater disinfection facilities under a wide range of conditions. A relatively good prediction was obtained at each plant. The model appeared to be sensitive to changes in water quality characteristics and to changes in the physical characteristics of the ozone contact basin. An example calculation of ozone transfer efficiency is presented along with the effect of changes to some of the factors affecting transfer efficiency, such as changes in diffuser depth, plant elevation, ozone concentration, water quality (i.e., ozone demand), pH, detention time, temperature, and a combina-

tion of factors. It is concluded that the design model may be used to evaluate the effect of changes in plant design on transfer efficiency, but cannot provide an absolute value for transfer efficiency until difficult-to-measure parameters, such as bubble diameter, are known. (Author's abstract)
W88-10388

IDENTIFICATION AND QUANTIFICATION OF VOLATILE ORGANIC SPECIES DURING MICROBIAL TREATMENT OF LEACHATE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
S. Sikkema, E. Dienemann, R. Ahlert, and D. Kosson.
Environmental Progress ENVPDI, Vol. 7, No. 2, p 77-83, May 1988. 11 fig, 2 tab, 6 ref.

Descriptors: *Organic compounds, *Pollutant identification, *Chemical analysis, *Water pollution treatment, *Wastewater treatment, *Leachates, Microbial degradation, Biological wastewater treatment, Degradation, Anaerobic digestion, Aerobic digestion, Aerobic treatment, Bacteria, Aerobic bacteria, Anaerobic bacteria, Chromatography, Gas chromatography, Superfund sites, Performacne evaluation, Performance evaluation.

Sequential anaerobic/aerobic microbial populations, in a packed-bed configuration, were employed to biodegrade leachate from a high priority Superfund site. Leachate characteristics included up to 100 ppm (as carbon) volatile organic priority pollutants. Identification and quantification of these pollutants at key steps in the biodegradation process is important. A method employing purge and trap concentration followed by gas chromatographic separation was developed for accurate identification and quantification of the volatile compounds of interest. Results obtained from application of this method to the leachate treatment process indicated that 84 to 99% of the specific volatile priority pollutants were biodegraded, under anaerobic conditions, during steady-state operation. (Author's abstract)
W88-10405

SIMULTANEOUS REMOVAL OF OIL AND HEAVY METALS FROM INDUSTRIAL WASTEWATER BY JOINT PRECIPITATION AND AIR FLOTATION,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
V. C. Gopalratnam, G. F. Bennett, and R. W. Peters.
Environmental Progress ENVPDI, Vol. 7, No. 2, p 84-92, May 1988. 11 fig, 5 tab, 14 ref.

Descriptors: *Wastewater treatment, *Flotation, *Precipitation, *Industrial wastewater, *Heavy metals, *Oil, Wastewater, Performance evaluation, Hydroxides, Hydroxides, Hydrogen ion concentration, Air injection, Separation techniques, Polymers, Adsorption, Zinc, Copper, Lead.

A joint precipitation and air flotation system was used to simultaneously remove oil and heavy metals from an industrial wastewater. The wastewaters were subjected to hydroxide treatment and chemical collectors simultaneously. The flotation tests were run for 4 min. For the particular wastewaters studied, the optimal pH and air injection rate was 9.18 and 12,150 cu cm/min, respectively. Three different chemical collectors were investigated (WOF-67, Nalco-7182, and Jayfloc-806); the optimal collector dosage was typically in the range of 2-5 mg/L (depending on the particular chemical collector and heavy metal of concern). Removals of the heavy metals and oil typically exceeded 85%; oil removals as great as 96.2% were achieved. Removal of the heavy metals and oil probably occurred through a coprecipitation-adsorption mechanism. Removals of the various heavy metals compared favorably between the individual removal and simultaneous removal (of heavy metals and oil) studies. The selectivity for individual metal species can be affected by appropriate choice of the chemical collector, its dosage, pH, and air injection rate. (Author's abstract)
W88-10406

LAMELLA SETTLERS: MATERIAL BALANCES AND CLARIFICATION RATES,
Lawrence Livermore National Lab., CA.
A. Maimoni.
Environmental Progress ENVPDI, Vol. 7, No. 2, p 93-98, May 1988. 16 fig, 16 ref. US DOE Contract W-7405-ENG-48.

Descriptors: *Sedimentation, *Lamella settlers, *Clarification, *Wastewater treatment, *Water treatment, *suspended solids, Hydraulic models, Mathematical models, Aluminum hydroxide, Particle size, Solids, Hydrodynamics, Algorithms, Mathematical studies.

Lamella settlers are effective sedimentation devices, low in energy intensity, used extensively in water plants and in the mineral industry. They consist of a set of parallel plates into which a slurry is fed to obtain gravitational separation. The clarified liquid collects under each of the plates and flows upward to the overflow, and the solids settle and flow along the bottom of each plate to be collected in the underflow. It is shown, using an algorithm based on a simple geometric model, that material balances and clarification rates of a lamella settler can be obtained from the particle size distribution and density of the solid, the density and viscosity of the liquid, the desired concentration of solids in the overhead product, and the concentration of solids in the feed and underflow. The method was validated using concentrated suspensions (up to 20 vol% solids) of four different feed-particle size distributions of hydrargillite (aluminum hydroxide) in water. Most of the data were obtained in a 60-cm-long settler with 1-cm plate separation inclined at 60 deg to the horizontal in 'open bottom' and 'normal' configurations. The algorithm is not applicable to tube settlers, whose hydrodynamics are more complex. (Author's abstract)
W88-10407

CATALYTIC OXIDATION OF GROUNDWATER STRIPPING EMISSIONS,
Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
For primary bibliographic entry see Field 5G.
W88-10409

REMOVAL OF POLLUTANTS FROM DILUTE WASTEWATER BY THE PACT TREATMENT PROCESS,
Zimpro, Inc., Rothschild, WI.
M. J. Dietrich, W. M. Copa, A. K. Chowdhury, and T. L. Randall.
Environmental Progress ENVPDI, Vol. 7, No. 2, p 143-149, May 1988. 2 fig, 9 tab.

Descriptors: *Wastewater treatment, *Activated carbon, *Activated sludge process, *Chemical oxygen demand, Carbon, Sludge, Wastewater, Industrial wastewater, Municipal wastewater, Adsorption, Performance evaluation, Wastes, Industrial wastes, Chemical wastes, Metal-finishing wastes, Biological wastewater treatment, Leachates, Runoff, Pesticides, Phenols.

The PACT wastewater treatment system which incorporates the use of powdered activated carbon in a conventional activated sludge system, has been used for the treatment of wastewaters from both municipal and industrial sources. The combination of physical adsorption with biological oxidation and assimilation in the PACT system has been shown to be particularly effective in treating dilute wastewaters which are variable in concentration and composition, highly colored, or contain materials which are refractive or potentially toxic to biological growth. Dilute wastewaters treated successfully in bench-scale PACT systems include those from organic chemicals, pharmaceuticals, metal coating, shale oil retort water, evaporation ponds, leachates, and rainwater runoff. The COD of these wastewaters ranged from a low of 643 mg/l to 23,700 mg/l. Specific pollutants present included compounds such as phenols, cyanides, thiocyanate, pesticides, and priority pollutants. The PACT wastewater treatment process has successfully treated these wastewaters and produced effluents meeting POTW or direct environmental discharge requirements. Operational parameters and performance results obtained for a number of bench-scale PACT systems are presented. (Author's abstract)
W88-10410

RHIZOSPHERE OXYGENATION BY TYPHA DOMINGENSIS PERS. IN MINIATURE ARTIFICIAL WETLAND FILTERS USED FOR METAL REMOVAL FROM WASTEWATERS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
J. S. Dunbabin, J. Pokorny, and K. H. Bowmer.
Aquatic Botany AQBODS, Vol. 29, No. 4, p 303-317, January 1988. 4 fig, 4 tab, 24 ref. append.

Descriptors: *Biological wastewater treatment, *Rhizosphere, *Heavy metals, *Wetlands, *Wastewater oxidation, *Wastewater treatment, *Aquatic plants, Artificial wetland filters, Cattails, Oxygen balance, Respiration, Plant physiology.

Miniature artificial wetland filters were used to treat a metal-enriched synthetic effluent by upward percolation through a gravel substratum. The systems were either planted with Typha domingensis Pers., or unplanted, and were with or without lactic acid or ground leaves as carbon amendments to enhance biological oxygen demand. Oxygen concentration, pH, redox potential and metal retention were higher in planted systems than in systems without plants. Respiration was increased by carbon amendments in all filters. Oxygen concentration in unplanted filters declined, but rhizosphere aeration maintained oxygenated conditions in all planted filters. Available carbon supply improved heavy metal removal in the artificial wetland filters and affected the rate of rhizosphere oxygenation. Rhizosphere oxygenation, calculated from the sum of respiration and net oxygenation observed in static assay, was of the order of at least 80-300 micrograms/l/h, or 210-750 micrograms/h/filter. (Author's abstract)
W88-10554

CYCLING AND RETENTION OF NITROGEN AND PHOSPHOROUS IN WETLANDS: A THEORETICAL AND APPLIED PERSPECTIVE,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2H.
W88-10675

PROBLEMS AND POTENTIAL FOR IN SITU TREATMENT OF ENVIRONMENTAL POLLUTANTS BY ENGINEERED MICROORGANISMS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5G.
W88-10743

MEMBRANE DISTILLATION IN THE TREATMENT OF AQUEOUS SOLUTIONS,
Naples Univ. (Italy). Dept. of Chemical Engineering.
E. Drioli, Y. Wu, and V. Calabro.
Journal of Membrane Science JMMRAO, Vol. 33, No. 3, p 277-284, October 1987. 11 fig, 2 tab, 8 ref.

Descriptors: *Distillation, *Membrane distillation, *Water treatment, *Wastewater treatment, *Membrane processes, Solutions, Solute transport, Temperature effects, Water chemistry, Membranes.

When a microporous membrane separates two aqueous solutions at different temperatures, selective mass transfer across the membrane can be obtained. The driving force is the vapor pressure difference between the liquids at the two solution-membrane interfaces. A capillary polypropylene membrane has been tested at different temperature

differences, solute concentrations, etc. Interesting transmembrane fluxes and selectivities have been consistently observed. The possibility of operating at very high solute concentrations up to saturation has been demonstrated. (Author's abstract)
W88-10761

USE OF INDUSTRIAL EFFLUENTS FOR THE CULTIVATION OF SPIRULINA,
Calcutta Univ. (India). Dept. of Botany.
R. Pal, and P. Chatterjee.
Bangladesh Journal of Botany BJBTB3, Vol. 17, No. 1, p 89-93, June 1988. 2 fig, 14 ref.

Descriptors: *Effluents, *Industrial wastewater, *Biological wastewater treatment, *Wastewater treatment, *Algae, Culturing techniques, Biomass, Cyanophyta, India.

The reclamation of industrial waste through algal mass culture in India was investigated. Spirulina platensis, a highly proteinaceous (65%), vitaminous blue green algae was used and the extent to which the algae can ameliorate the pollution level of factory waste was studied. Initial growth of the algae implied that it can use the macro- and micro-nutrients of the waste for growth and can produce biomass satisfactorily. It was evident that this algae can be profitably cultured in industrial waste to lower the pollution level and at the same time convert the waste to a useful biomass. (Miller-PTT)
W88-10789

ROTIFER FAUNA OF TWO SEWAGE CHANNELS OF GWALIOR (INDIA),
Jiwaji Univ., Gwalior (India). School of Studies in Zoology.
D. N. Saksena, and N. Kulkarni.
Limnologica LMNOA8, Vol. 17, No. 1, p 139-148, April 1986. 24 fig, 1 tab, 46 ref.

Descriptors: *Aquatic animals, *Rotifers, *Wastewater outfall, *Sewers, *India.

Twenty species of the class rotifera belonging to five families and eleven genera were collected in two sewage channels. The species described are Brachionus calyciflorus, B. falcatus, B. bidentatus, B. quadridentatus, B. angularis, B. rubnes, B. patulus, Keratella tropica, Platyias quadricornis, Mytilina ventralis, Trichotria tetractis, Lecane ludwigi, L. curvicornis, L. luna, Monostyla bulla, M. quadridentata, Trichocerca cylindrica, Polyarthra vulgaris, Testudinella patina and Filinia longiseta. Out of these species, Trichotria tetractis is present in Swarna Rekha channel only, and Brachionus bidentata, B. falcatus, B. patulus, Mytilina ventralis, Lecane ludwigi, L. curvicornis, Monostyla quadridentata, Trichocera cylindrica, Testudinella patina species are present in Morar sewage channel only, while the rest of the rotifers are represented in both. (Author's abstract)
W88-10803

POSSIBILITY OF ASSESSING THE TROPHIC POTENTIAL IN ORGANICALLY POLLUTED WATERS,
Ceskoslovenska Akademie Ved, Prague.
J. Lukavsky, A. Lukavska, and J. Kvet.
Limnologica LMNOA8, Vol. 17, No. 2, p 355-363, October 1986. 16 fig, 2 tab, 14 ref.

Descriptors: *Trophic level, *Waste water treatment, *Eutrophication, *Animal wastes, *Water pollution, *Path of pollutants, Nitrates, Animal populations, Population exposure, Poultry, Chemical oxygen demand, Ponds, Biological oxygen demand, Productivity, Bioassay.

Self-purification and dilution of pollutants were followed in a cascade of four small ponds of which the first received untreated effluents from a farm for raising ducks (BOD sub 5 up to 384 mg/l O2). The chemical oxygen demand (COD), biological oxygen demand (BOD5), trophic potential assessed by the Microtest-method of algal growth (AGP), and the concentration of total P, PO4(3-)-P, NH4(+)-N, K, Ca, Mg and Na, all decreased by one to two orders of magnitude along the cascade. The last pond in the cascade received only little polluted water from the preceding ponds during the growing season so that the water quality in it permitted its management for fish production. The concentrations of NO2(-)-N and NO3(-)-N were inversely proportional to those of NH4(+)-N, which indicates the transformation of organic N forms into their inorganic forms. The trophic potential was most closely correlated with the BOD sub 5 and the NH4(+)-N concentration, followed by that of PO4(3-)-P. Saprobity can therefore be evaluated quantitatively by the algal bioassay; the BOD sub 5 to AGP conversion is best described by the equation AGP = 0.21 + 0.21 in BOD sub 5. (Author's abstract)
W88-10815

ANAEROBIC ACIDOGENESIS OF A COMPLEX WASTEWATER: I. THE INFLUENCE OF OPERATIONAL PARAMETERS ON REACTOR PERFORMANCE,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
G. Dinopoulou, T. Rudd, and J. N. Lester.
Biotechnology and Bioengineerng BIBIAU, Vol. 31, No. 9, p 958-968, June 5, 1988. 10 fig, 2 tab, 30 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Anaerobic digestion, Fermentation, Reactors, Chemical oxygen demand, Retention time.

The influence of operational parameters, such as hydraulic retention time, organic loading rate, influent substrate concentration, pH, and temperature, on the performance of the first phase of anaerobic digestion was investigated. A complex substrate based on beef extract was used, and six series of experimental runs were conducted, each one showing the effect of one operational variable. The predominant fermentation products were always acetic and propionic acid, independent of the values of the operational parameters. For initial COD concentrations and hydraulic retention times above the critical values identified as 3 g/l and 6 h, respectively, the degree of acidification achieved was between 30-60%. The degree of acidification increased with the hydraulic retention time and decreased with the influent substrate concentration and organic loading rate, while the opposite held true for the rate of product formation. It was demonstrated that acidification is primarily determined by the hydraulic retention time and the rate of product formation by the influent substrate concentration. The concentration of the acetic acid produced depended on the operational parameters. The concentration of the propionic acid produced depended only on the substrate availability with a consistent proportion of 8% initial COD converted to it. The optimum pH and temperature were 7 and 40 C, respectively. The percentage of acetic acid as a proportion of the total volatile fatty acids produced increased with increasing pH and temperature, while the percentage of propionic acid seemed to decrease accordingly. The effect of the temperature on the rate of acidification followed an Arrhenius type equation with an activation energy equal to 4739 cal/mol. (See also W88-10896) (Author's abstract)
W88-10895

ANAEROBIC ACIDOGENESIS OF A COMPLEX WASTEWATER: II. KINETICS OF GROWTH, INHIBITION, AND PRODUCT FORMATION,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
G. Dinopoulou, R. M. Sterritt, and J. N. Lester.
Biotechnology and Bioengineerng BIBIAU, Vol. 31, No. 9, p 969-978, June 5, 1988. 6 fig, 8 tab, 36 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Model studies, *Anaerobic digestion, Fermentation Reactors, Chemical oxygen demand, Growth kinetics, Kinetic models, Mathematical models.

The kinetics of the acidogenic phase of anaerobic digestion were studied in continuous culture using a complex substrate based on beef extract. A number of different steady states was achieved covering a wide range of hydraulic retention times and product concentrations. The Monod equation failed completely to describe the growth of the acidogenic bacteria, while there was evidence of product inhibition. Therefore, two of the most commonly used inhibition models were applied, the noncompetitive and the Haldane-type model. The former gave superior results, and the estimated values for the biokinetic constants were a maximum specific growth rate of 32.6/day, a substrate saturation constant of 1.77 g COD/l, an inhibition constant of 0.633 g/l of total volatile fatty acids, and a specific decay rate 1.747/day. The same inhibition models were also applied to the description of the specific rate of product formation, with the noncompetitive model fitting the data slightly better. The maximum specific rate of product formation was estimated to be 125.7 g total volatile fatty acid/g biomass/day. (See also W88-10895) (Author's abstract)
W88-10896

MODELING MICROBIAL FOULING IN POROUS MEDIA,
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
For primary bibliographic entry see Field 2F.
W88-10976

ACUTE TOXICITY OF CHLORINE ON FRESHWATER ORGANISMS: TIME-CONCENTRATION RELATIONSHIPS OF CONSTANT AND INTERMITTENT EXPOSURES,
MITRE Corp., McLean, VA.
For primary bibliographic entry see Field 5C.
W88-11007

USE OF MICROBIAL IN SITU TREATMENT FOR DETOXIFICATION OF A CONTAMINATED GROUND WATER,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-11061

SUITABILITY OF GLACIAL GEOLOGY AND HYDROGEOLOGY OF NORTHWEST WASHINGTON FOR SITING WASTE MANAGEMENT FACILITIES,
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 5E.
W88-11129

OVERVIEW OF THE NATIONAL DISCHARGE MONITORING REPORT (DMR) QUALITY ASSURANCE (QA) PROGRAM,
Environmental Protection Agency, Washington, DC. Office of Water Enforcement and Permits.
For primary bibliographic entry see Field 7C.
W88-11168

QUALITY ASSURANCE AS AN ELEMENT OF WISCONSIN'S NPDES PROGRAM,
Wisconsin Dept. of Natural Resources, Madison.
M. J. Kopecky, and L. Vogen.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 200-205, 3 tab.

Descriptors: *Quality control, *Wisconsin, *Wastewater treatment facilities, *Legal aspects, *Administrative regulations, Inspection, Laboratories, Water analysis, Data processing, Certification.

Wisconsin has a long history of concern about data quality in its Wisconsin Pollution Discharge Elimination System (WPDES) program. Since 1978, operators of municipal sewage treatment plants (STP) have been required to pass written and practical exams in laboratory operations to be certified to operate an STP. The Wisconsin Department of Natural Resources (WDNR) has also developed a program of laboratory evaluations and

Performance Audit Inspections (PAI). Results of these evaluations indicate that data quality is improving; however, problems still exist. These problems are related to insufficient operator knowledge of procedures, lack of routine quality control practices at laboratories, and insufficient support of the laboratories by municipal and industrial management. Wisconsin is proposing a laboratory certification program that would certify that a laboratory is actually producing data meeting set standards of accuracy and precision, as opposed to conventional programs which certify a laboratory's capability to produce accurate data. (See also W88-11158) (Author's abstract)
W88-11169

EVAPORATION OF BENZENE, TOLUENE, AND O-XYLENE FROM CONTAMINATED GROUND WATER,
Geraghty and Miller, Inc., Oak Ridge, TN.
P. D. Kuhlmeier.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 591-606, 3 fig, 3 tab, 9 ref.

Descriptors: *Benzenes, *Volatilization, *Wastewater treatment, *Groundwater pollution, *Sublimation, Comparison studies, Petroleum products, Hydrocarbons, Feasibility studies, Evaluations, Mass transfer.

Volatilization aided by agitation is a potentially cost-effective way to remove mixed aromatic hydrocarbons remaining in treating polluted groundwater after oil-water separation. A methodology that is useful for quantifying the transfer rates of three petroleum hydrocarbons from an agitated tank to the atmosphere. The methodology consists of comparing the overall liquid phase transfer rate constants (K sub L a) of benzene, toluene and o-xylene with one another at various controlled energy inputs. The bench scale approach is analagous in full scale to mechanical aerators in wastewater lagoons. Evaluations can be made to determine the feasibility of full scale surface pool aeration in removing soluble and partly soluble petroleum from water. A physical model is developed that represents well-mixed air and water phases separated by an interface with near stagnant films of air and water on either side. Equations are developed that reflect a situation in which a water body becomes depleted of a compound introduced as a slug, thus simulating system start-up. (See also W88-11213) (Friedmann-PTT)
W88-11246

SWAPS, AN AUTOMATED LIQUID HYDROCARBON RECOVERY SYSTEM,
Amoco Corp., Tulsa, OK.
For primary bibliographic entry see Field 5G.
W88-11247

REMEDIATION OF GASOLINE-CONTAMINATED GROUND WATERS: A CONTROLLED FIELD EXPERIMENT,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5G.
W88-11248

TREATMENT OF CONTAMINATED GROUND WATER WITH MEMBRANE SEPARATION TECHNOLOGIES,
C3 International, Minneapolis, MN.
For primary bibliographic entry see Field 5G.
W88-11249

HYDROGEOLOGIC ASSESSMENT, DELINEATION, AND REMEDIATION OF A SHALLOW GROUND WATER CONTAMINATED ZONE,
CIBA-GEIGY Corp., St. Gabriel, LA.
For primary bibliographic entry see Field 5G.
W88-11250

TREATMENT AND REMOVAL OF DISSOLVED ORGANICS AND INORGANICS IN A CONTAMINATED GROUND WATER - A CASE STUDY,
Stover and Associates, Stillwater, OK.
For primary bibliographic entry see Field 5G.
W88-11253

ADVANCED STAGES OF A HYDROCARBON RECOVERY/CLOSED LOOP HYDROCARBON FLUSHING SYSTEM SUCCESSFUL IN A HIGHLY PERMEABLE GLACIAL OUTWASH IN APPLE VALLEY, MINNESOTA,
Leggette, Brashears and Graham, Inc., St. Paul, MN.
For primary bibliographic entry see Field 5G.
W88-11257

PRODUCTION WATERS ASSOCIATED WITH THE PRODUCTION, PROCESSING, TRANSMISSION, AND STORAGE OF NATURAL GAS: A LITERATURE SURVEY,
ERT, Pittsburgh, PA.
J. P. Fillo, T. A. Hamacker, S. M. Koraido, R. G. Stefanacci, and J. T. Tallon.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-232153. Price codes: A14 in paper copy, A01 in microfiche. Topical Report (July 1985-March 1987) No. GRI-87/0126, July 1987. 283 p, 26 fig, 76 tab, 166 ref. GRI Contract No. 5084-253-1117.

Descriptors: *Literature review, *Natural gas, *Industrial wastewater, *Path of pollutants, *Wastewater treatment, Waste disposal, Biomonitoring, Water treatment, Drilling fluids, Fuel, Regulations, Legislation.

The available public literature on the source, characteristics, and management of production waters from natural gas industry operations is reviewed. Gas exploration, production, processing, transmission, and storage operations generate production waters that must be discharged or disposed in accordance with applicable environmental regulations. Disposal practices and regulations are coming under increased scrutiny by EPA for all industry, and regulatory changes are anticipated in the foreseeable future. Natural gas industry operations will be affected to some degree by potential changes in regulations governing management of production waters under the Resource Conservation and Recovery Act, the Underground Injection Control (UIC) program of the Safe Drinking Water Act (SDWA), and biomonitoring requirements for National Pollutant Discharge Elimination System (NPDES) discharges under the Clean Water Act (CWA). The availability of data on production water composition, biomonitoring, treatment, and disposal practices varies widely in the public literature. While chemical composition data are available for drilling fluids and produced waters, comprehensive detailed chemical analyses generally are not. Biomonitoring data are available only for drilling fluids, with few exceptions. Few data are available for waters from processing, transmission, and storage operations. Although treatment and disposal practices are described in the literature, the extent specific practices are used to manage each production water is poorly documented. (Author's abstract)
W88-11268

WASTE TO ENERGY APPLICATIONS IN THE WISCONSIN CANNING INDUSTRY: ECONOMIC AND ENVIRONMENTAL EVALUATION OF ANAEROBIC TREATMENT OF VEGETABLE PROCESSING WASTEWATERS USING A FIXED FILM REACTOR,
Wisconsin Div. of State Energy and Coastal Management, Madison.
C. R. Stack, and E. L. Stover.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-009881. Price codes: A03 in paper copy, A01 in microfiche. DOE Report No. DOE/CS/69135--T3, January 1987. 41 p, 2 fig, 8 tab, 18 ref. DOE Grant DE-FG-02-89 CS69135.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Canneries, Retention time, Chemical oxygen demand, Anaerobic digestion, Wisconsin, Methane, Economic aspects, Performance evaluation, Industrial wastewater, Pilot plants, Capitol costs.

A pilot scale, upflow fixed film anaerobic reactor was utilized to determine pollutant removal efficiency, operational parameters, and basis of design of conceptual full scale systems at a vegetable canning plant. Hydraulic retention times as low as twelve hours and organic loading rates as high as 1.6 pounds total chemical oxygen demand (COD) per cubic foot of media per day were achieved during the pilot study. The biogas produced from the anaerobic treatment pilot system typically contained 60 to 65% methane. About 3.0 cu ft of methane (5.5 cu ft of biogas) were produced at standard temperature and pressure per one pound of total COD removed. Wastewaters used in this study were highly variable in their strength and chemical composition. Based upon the results of the pilot study, the projected economics of different hypothetical wastewater treatment options were examined and compared to the economics of the present waste disposal program. The anaerobic treatment alternatives that were examined required large initial capital investments but yielded positive, although long, returns on investment. The aerobic treatment alternative also required a large initial capital investment and did not yield any return on investment due to high operating cost. It was determined that anaerobic treatment would probably be more desirable than aerobic treatment if wastewater treatment were ever required at this facility. (Lantz-PTT)
W88-11277

NATURAL SYSTEMS FOR WASTE MANAGEMENT AND TREATMENT,
S. C. Reed, E. J. Middlebrooks, and R. W. Crites.
McGraw-Hill Book Co., New York. 1988. 308 p.

Descriptors: *Waste management, *Wastewater treatment, *Stabilization ponds, *Aquaculture, Sludge, Sludge digestion, Biological treatment, Wetlands, Land disposal, Permeability, Infiltration, Duckweed, Groundwater movement, Water hyacinth, Sludge disposal.

Waste management processes that depend to the maximum degree on natural components and to a minimal degree on mechanical elements can reduce the costs, process energy, and complexity of operation. These natural processes should be given priority consideration for planning new systems and for upgrading or retrofitting existing systems. Some of the processes included in this book, such as pond systems, may be familiar to many engineers, but the text presents simplified, easy-to-use design procedures. Other, less familiar concepts can also provide very effective treatment for a significantly lower cost than mechanical treatment alternatives. Planning, feasibility assessment, and site selection; basic process responses and interactions; wastewater stabilization ponds; aquaculture systems; wetland systems; land treatment systems; and sludge management and treatment systemsare discussed. (Lantz-PTT)
W88-11290

5E. Ultimate Disposal Of Wastes

INFLUENCE OF IRRIGATION WITH LEACHATE ON BIOMASS PRODUCTION AND EVAPOTRANSPIRATION ON A SANITARY LANDFILL,
Insinoori- ja Limnologitoimisto Oy Vesitekniikka A.B., Salpakangas (Finland).
M. Ettala.
Aqua Fennica AQFEDI, Vol. 17, No. 1, p 69-86, 1987. 9 fig, 9 tab, 68 ref.

Descriptors: *Wastewater irrigation, *Irrigation effects, *Leachate, *Evapotranspiration, *Sanitary landfills, *Willow trees, Finland, Biomass, Trees.

The influence of irrigation with leachate on biomass production and evapotranspiration was studied on three sanitary landfills in southern Finland in 1982-1984. Irrigation with leachate increased

biomass production significantly. The quality of the irrigation water and substrate, mode of irrigation and tree species also influenced biomass production. In a willow stand, 30% of the irrigation and precipitation was intercepted. Evapotranspiration calculations based on biomass production measurements gave results similar to the values obtained with the Penman-Monteith equation. Irrigation with leachate was found to increase evapotranspiration on a sanitary landfill. (Author's abstract)
W88-10116

INFILTRATION AND HYDRAULIC CONDUCTIVITY AT A SANITARY LANDFILL,
Insinoori- ja Limnologitoimisto Oy Vesitekniikka A.B., Salpakangas (Finland).
M. Ettala.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 231-237, 1987. 5 fig, 3 tab, 19 ref.

Descriptors: *Sanitary landfills, *Leachate, *Infiltration, *Hydraulic conductivity, Water level, Water balance, Saturated flow.

Field studies of infiltration and hydraulic conductivity were carried out at two sanitary landfills differing in their disposal technology. At both sites the infiltration rate mostly exceed 1 mm/min, so that surface runoff was small. The saturated hydraulic conductivity of the landfill with strong compaction was estimated at 0.000059 - 0.0004.8 m/s and that of the landfill with only slight compaction at 2.1 - 0.0025. Besides depending on the disposal technology, hydraulic conductivity varied in different parts of the same landfill. (Author's abstract)
W88-10125

EFFECTS OF IRRIGATION WITH RAW AND DIFFERENTIALLY DILUTED SEWAGE AND APPLICATION OF PRIMARY SETTLED SEWAGE-SLUDGE ON WHEAT PLANT GROWTH, CROP YIELD, ENZYMATIC CHANGES AND TRACE ELEMENT UPTAKE,
National Environmental Engineering Research Inst., Nagpur (India).
For primary bibliographic entry see Field 5B.
W88-10197

EFFECTS OF A SEWAGE TREATMENT PLANT ON THE PHYSICO-CHEMICAL QUALITY AND COMMUNITY STRUCTURE OF THE BENTHIC FAUNA OF A POLLUTED RIVER, THE HAUTE-SEMOIS (ETUDE DES EFFETS D'UNE STATION D'EPURATION SUR LA QUALITE PHYSICO-CHIMIQUE ET LA STRUCTURE DE PEUPLEMENT DE LA FAUNE BENTHIQUE D'UNE RIVIERE POLLUEE, LA HAUTE-SEMOIS),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. de Biologie Quantitative.
For primary bibliographic entry see Field 5C.
W88-10281

SNOW COVER AND MAXIMUM LEACHATE DISCHARGE OF A SANITARY LANDFILL,
Insinoori- ja Limnologitoimisto Oy Vesitekniikka A.B., Salpakangas (Finland).
For primary bibliographic entry see Field 5B.
W88-10304

SUMMARY OF RESULTS FROM THE SWEDISH PROJECT 'ENVIRONMENT/CELLULOSE',
Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 5C.
W88-10314

PRACTICAL EXPERIENCES IN ACTIVATED SLUDGE TREATMENT WITHIN THE METSA-SERLA GROUP,
For primary bibliographic entry see Field 5D.
W88-10315

SLUDGE HANDLING AND DISPOSAL AT FINNISH ACTIVATED SLUDGE PLANTS,
Finnish Pulp and Paper Research Inst., Helsinki.
R. Saunamaki.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 171-182, 1988. 12 fig, 20 ref.

Descriptors: *Finland, *Sludge, *Sludge disposal, *Sludge conditioning, *Activated sludge process, *Pulp and paper industry, *Pulp wastes, Activated sludge, Wastes, Industrial wastes, Industrial plants, Wastewater treatment, Mills, Sludge thickening, Sedimentation, Clarifiers, Clarification, Aeration, Incineration, Landfills.

Between 1984 and 1986, a total of 13 activated sludge treatment plants were built in Finland to handle wastewaters from pulp and paper mills. With just a few exceptions, these plants have come up to expectations, achieving BOD7 reductions of 80-95%. These plants produce around 94,000 tons (dry weight) of sludge a year, of which some 27,000 tons is biosludge. On a mill basis, biosludge accounts for 10-50% of total sludge. Generally speaking, the higher the loading at the plant, the more biosludge is produced. *The biosludge is separated by sedimentation in clarifiers and thickened in round sedimentation basins to a consistency of 3-5%. At one mill, anaerobic sludge from an oversized thickener is returned to the aeration basin. The aim of this is to minimize the need for nutrient addition. Belt filter presses are normally used for sludge dewatering, the solids contents achieved being about 25-37%. The difficulty of handling biosludge and the low solids contents achieved were considered by many mills to be the main problems of sludge handling. At one mill, a drum press is used to press a pretreated mixture of sludge and bark to around 42% consistency for burning. Six mills burn all or part of their sludge in a bark-fired boiler. On a dry weight basis, the sludge burned normally accounts for 5-10% of total fuel consumption. Burning sludge has been associated with a reduction in steam generation and an increase in running problems. The other method of disposing of sludge is landfilling. Sludge is not used as a fertilizer or soil improvement agent in Finland. (Author's abstract)
W88-10327

TREATMENT AND CHARACTERIZATION OF BIOLOGICAL SLUDGES FROM THE PULP AND PAPER INDUSTRY,
Technical Research Center of Finland, Helsinki.
H. L. Kyllonen, M. K. Lappi, R. T. Thun, and A. H. Mustranta.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 183-192, 1988. 6 fig, 4 tab, 9 ref.

Descriptors: *Activated sludge, *Sludge, *Sludge drying, *Sludge conditioning, *Pulp and paper industry, Finland, Filtration, Chemical composition, Particle size, Biological treatment, Chemical treatment, Enzymes, Sedimentation.

Various ways of releasing bound water from the pulp waste sludges were investigated, with particular emphasis on developing correlations between measurable sludge properties and dewatering behavior. Activated sludges of different origins were subjected to various chemical, thermal, and enzymatic treatments. The effects of these conditioning treatments on sludge properties of the sludges have been characterized by measuring changes in the specific resistance to filtration, the amount of water bound in different ways, the particle size distribution, and the chemical composition of the sludges. Results of these experiments are discussed. Results are difficult to interpret, since treatment effects differ depending on sludge properties. Thermal treatment of sludges proved to be the most effective method for breaking water binding, although the most influential factor could not be identified. Ultrasonic treatment had a clear effect on the particle size distribution and settling of the sludges, but not on dewaterability, and proved to be closely related to the individual sludge. The enzymes tested had no significant effect on the dewatering characteristics of the sludges. The results obtained so far will be used for designing an optimal sludge treatment process in future work. (Author's abstract)
W88-10328

EFFECT OF TEMPERATURE ON ANAEROBIC DIGESTION OF PULP AND PAPER INDUSTRY WASTEWATER SLUDGES,
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
J. A. Puhakka, M. A. Viitasaari, P. K. Latola, and R. K. Maatta.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 193-201, 1988. 2 fig, 4 tab, 16 ref.

Descriptors: *Temperature effects, *Anaerobic digestion, *Sludge digestion, *Pulp wastes, *Pulp and paper industry, *Sludge, *Activated sludge, Degradation, Biodegradation, Digestion, Primary sludge, Retention time, Chromatography, Gas chromatography, Sludge thickening, Suspended solids.

Mesophilic and thermophilic digestion of wastewater sludges from the forest industry were studied in semicontinuous flow reactors. Laboratory scale reactors were used for anaerobic treatment studies of a mixture of primary and secondary sludges from a chemi-thermomechanical pulp (CTMP) mill. The volatile suspended solids (VSS) reductions in mesophilic and thermophilic digestion of combined CTMP sludge were 41 and 36%, respectively. Specific gas production in the mesophilic process was 0.09 cu m/kgVSS added or 0.38 cu m/kgVSS reduced. In thermophilic digestion, the respective numbers were 0.05 and 0.13. The mesophilic digestion process was stable at an organic loading rate of 2.5 kgVSS/cu m/day, which represents a 15-day retention time. The supernatant quality of thermophilic digestion was poor (CODsol usually between 3,000 and 4,000 mg/l) compared with the supernatant of mesophilic digestion (CODsol 1,000-2,000 mg/l). (Author's abstract)
W88-10329

USING THE CAPILLARY SUCTION TIME DEVICE FOR CHARACTERIZING SLUDGE DEWATERABILITY,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7B.
W88-10330

LANDSPREADING DIOXIN-CONTAMINATED PAPERMILL SLUDGE: A COMPLEX PROBLEM,
Wisconsin Dept. of Health and Social Services, Madison. Bureau of Community Health and Prevention.
L. J. Olson, H. A. Anderson, and V. B. Jones.
Archives of Environmental Health AEHLAU, Vol. 43, No. 2, p 186-189, March/April 1988. 2 tab, 26 ref.

Descriptors: *Sludge disposal, *Land disposal, *Pulp wastes, *Dioxins, *Fate of pollutants, *Environmental protection, *Chlorinated hydrocarbons, *Population exposure, Waste disposal, Risks, Forests, Fields, Sludge, Industrial wastes, Wastes, Hydrocarbons, Path of pollutants, Toxicity, Carcinogens, Public health, Decision making, Administrative decisions, Contamination.

The complex factors involved in the issue of applying dioxin-contaminated papermill sludge to agricultural and silvicultural lands in central Wisconsin are reviewed. Among the exposure and risk assumption issues discussed are application of dioxin and furan equivalent factors; acceptable daily intake levels; cancer risk levels; and exposure scenarios, including food, air, dermal, and soil ingestion. Available management options range from banning any use of dioxin-contaminated sludge to establishing acceptable or tolerable contamination limits. After the sludge is amended to the soils, the dioxin concentration is expected to drop anywhere from 10- to 100-fold from the sludge level, while a preliminary assessment of potential human exposure scenarios found a many thousand-fold range of risk. The recommendations and approaches of various states and the Centers for Disease Control are discussed. It is concluded that the issue is extremely complex and must be evaluated on a case-by-case basis. A final major risk assessment

decision is whether to use the worst-case approach consistently, possibly greatly overstating the health risks, or to develop a most plausible exposure scenario and direct any regulatory actions along this line. (Author's abstract)
W88-10391

CALCUTTA POLLUTANTS: PART 1. APPRAISAL OF SOME HEAVY METALS IN CALCUTTA CITY SEWAGE AND SLUDGE IN USE FOR FISHERIES AND AGRICULTURE,
Jadavpur Univ., Calcutta (India). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-10527

ANALYSIS OF SUBSURFACE STRATIGRAPHY OF THE SANITARY LANDFILL, URBANA, ILLINOIS,
Illinois Univ., Urbana. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-10551

SORPTION OF COPPER AND CADMIUM FROM THE WATER-SOLUBLE FRACTION OF AN ACID MINE WASTE BY TWO CALCAREOUS SOILS,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
For primary bibliographic entry see Field 5B.
W88-10570

DETERMINING PATHOGEN LEVELS IN SLUDGE PRODUCTS,
For primary bibliographic entry see Field 5A.
W88-10637

ON-FARM COMPOSTING OF LAKE WEEDS,
Clark Engineering, Lebanon, NY.
B. Spencer.
Biocycle BCYCDK, Vol. 29, No. 5, p 54-55, May/June 1988. 1 fig.

Descriptors: *Compost, *Farming, *Waste disposal, *Fertilizers, Weeds, Aquatic weeds, Lakes, Corn, Crop production.

Weeds have become a serious problem in lakes throughout the northeastern United States. This article describes how a Massachusetts farmer demonstrated that harvested lake weeds can be rapidly composted and incorporated into corn fields as a fertilizer. The goal of the composting project was to sufficiently degrade the weeds so that they could be applied to the soil with a manure spreader without snarling the spreader. Within three months of static pile composting, the weeds used has disintegrated sufficiently, and approximately one-half of the 900 tons accumulated were applied to a nearby corn field that fall. Biological decomposition slowed considerably in the portion of the weeds that were stored through the winter and then plowed into the soil the following spring. Fertilizer value of the 900 tons of weeds was estimated at 139 pounds of nitrogen per acre, 44 pounds of phosphorus, and 27 pounds of potassium. (Friedmann-PTT)
W88-10638

ENERGY HEAD IMPLICATIONS OF THE INSTALLATION OF CIRCULAR FLAP GATES ON DRAINAGE OUTFALLS,
Liverpool Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W88-10764

USE OF INDUSTRIAL EFFLUENTS FOR THE CULTIVATION OF SPIRULINA,
Calcutta Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5D.
W88-10789

COMPARATIVE STUDY OF SPECIES COMPOSITION, DENSITY AND SPECIES DIVERSITY OF THE PHYTOPLANKTON IN A NON-POLLUTED AND A SEWAGE RECEIVING FRESHWATER RESERVOIR,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W88-10890

WASTE CONFINEMENT PERFORMANCE OF DEEP INJECTION WELLS,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-10950

MODELING STUDY OF THE CULEBRA DOLOMITE,
INTERA Technologies, Inc., Austin, TX.
For primary bibliographic entry see Field 2F.
W88-10953

COMBINED MODELING PROGRAM FOR EVALUATING THE COVER DESIGN AT A URANIUM MILL TAILINGS DISPOSAL SITE,
Colorado Geological Survey, Denver.
W. Wright, and A. K. Turner.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 853-869, 6 fig, 1 tab, 10 ref.

Descriptors: *Path of pollutants, *Water quality control, *Groundwater pollution, *Mine wastes, *Model studies, *Uranium, Waste disposal, Model studies, Mathematical models, Leachates, HELP model, Durango, Colorado, Infiltration, Chemical precipitation, Industrial wastes.

A modeling program for evaluating the performance of a proposed cover at a uranium mill tailings disposal location was applied to the site's design. In this application the volume of leachate from the base of the proposed tailings impoundment was estimated by two methods: a fundamental Darcian-style analysis and with the HELP (Hydrologic Evaluation of Landfill Performance) computer model. Leachate estimates by both techniques were in reasonable agreement. The potential impacts to the local groundwater regime were assessed initially by diluting the leachate flux, predicted by the HELP model, with the estimated volume of groundwater available for dilution. Following this, the potential for leachate attenuation from chemical precipitation was simulated with the geochemical speciation code PHREEQE (pH redox equilibrium equations). The volume and estimated composition of the leachate was mixed with the volume and chemical character of the existing groundwater by using the mixing mode of PHREEQE. (See also W88-10912) (Cassar-PTT)
W88-10954

MODELING OF GROUND WATER FLOW THROUGH A WP-CAVE,
Uppsala Geosystem A.B. (Sweden).
C.-L. Axelsson, and T. Olsson.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 870-887, 10 fig, 3 tab, 6 ref.

Descriptors: *Radioactive waste disposal, *Model studies, *Groundwater barriers, *Path of pollutants, *Water quality control, Groundwater pollution, Waste disposal, Mathematical models, Underground waste disposal, Caves, WP-Cave, Hydraulic cage, Hydraulic conductivity, Leachates, Barriers, Boreholes.

Three-dimensional groundwater modeling was performed to determine the efficiency of different hydraulic barriers included in the WP-Cave concept for nuclear waste disposal. The WP-Cave concept is a centrally located cave in which spent nuclear fuel canisters are deposited. Outside the cave are two barriers: an innermost barrier with an excavated slot filled with a mixture of bentonite and sand and an outer barrier with a hydraulic cage, made by tunnels connected to each other by a borehole mesh. The WP-Cave is located 200-250 m below the surface in a rock mass with low hydraulic conductivity. Two-dimensional analysis showed that a cage made by 300 boreholes produces a 99% reduction in groundwater flow through the cage. The efficiency of the bentonite-sand barrier is governed by the difference in hydraulic conductivity between the bentonite-sand barrier and the surrounding rock mass. The reduction in groundwater flow is about 35% if the bentonite-sand barrier can be constructed with a hydraulic conductivity 10 times lower than that of the rock mass. (See also W88-10912) (Cassar-PTT)
W88-10955

MODELING AREAL, VARIABLE-DENSITY, GROUND-WATER FLOW USING EQUIVALENT FRESHWATER HEAD: ANALYSIS OF POTENTIALLY SIGNIFICANT ERRORS,
Geological Survey, Albuquerque, NM.
For primary bibliographic entry see Field 2F.
W88-10956

APPLICATION OF STOCHASTIC GROUND WATER MODELS TO GEOLOGIC DISPOSAL OF HIGH-LEVEL NUCLEAR WASTE,
Rockwell International, Richland, WA. Rockwell Hanford Operations.
B. Sagar, P. M. Clifton, and A. J. Knepp.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 904-925, 7 fig, 41 ref.

Descriptors: *Hydraulic models, *Model studies, *Water quality control, *Groundwater pollution, *Radioactive waste disposal, Waste disposal, Mathematical models, Basalt Waste Isolation Project, Hanford Site, Washington, Stochastic process, Monte Carlo method.

Stochastic methods considered for application to high-level nuclear waste disposal at the Basalt Waste Isolation Project, Hanford Site, Washington, were reviewed. Methods presently used by groundwater hydrologists to analyze the uncertainty in predictions of flow and transport through porous or fractured media are of five general types: Monte Carlo, finite order, perturbation, analytic time or frequency domain, and stochastic Lagrangian techniques. The Monte Carlo method was chosen for practical application because of its relative simplicity. The three applications were modeling of the source term (release and migration of the radionuclides in the immediate area of deposition), groundwater travel time, and radionuclide transport in the far field. It was concluded that considerably more research and development on stochastic models is necessary before they can be routinely used in analysis of groundwater problems. (See also W88-10912) (Cassar-PTT)
W88-10957

APPLICATION OF SEISMIC, EM AND RESISTIVITY TECHNIQUES TO DESIGN A GROUND WATER MONITORING PROGRAM AT A LANDFILL IN NORTHWESTERN ILLINOIS.
Geotechnology, Inc., St. Louis, MO.
For primary bibliographic entry see Field 7A.
W88-11043

CLASS I INJECTION WELL MONITORING: ISSUES AND ANSWERS,
Golden Strata Services, Inc., Houston, TX.
For primary bibliographic entry see Field 5G.
W88-11063

LABORATORY AND FIELD EVALUATION TECHNIQUES TO DETERMINE WASTE/AQUIFER COMPATIBILITY IN UNDERGROUND INJECTION SYSTEMS,
Davis (Ken E.) Associates, Houston, TX.
M. S. Pearce.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 543-567, 12 fig.

Descriptors: *Injection wells, *Core tests, *Underground waste disposal, *Groundwater movement, *Aquifers, On-site investigations, Field tests, Experimental data, Data interpretation, Fluid flow, Porous media, Cores, Well hole.

The types of tests that are required to assess waste/aquifer compatibility problems and the choice of appropriate remedial treatments are described. The application of the necessary principles of fluid flow through porous media are also presented in a manner that is useful to the injection-well operator. The discussion of laboratory testing includes the types of core tests that need to be performed, how to interpret core-test data, analytical test requirements, and physical measurements. Special attention is given to the use of tapped-core experiments and the added information available from these tests for interpreting the role that injected solids, clay sensitivity, and fluid-fluid interactions have on core permeability. The discussion of field tests covers the simplest of tests to help identify zones that are taking fluids, the bottom of the hole, and changes in flow before and after a stimulation treatment. All this information can be organized to give a consistent picture of downhole problems that are occurring. (See also W88-11031) (Author's abstract)
W88-11064

APPLICATION OF THE TEMPERATURE SURVEY IN DEMONSTRATING THE MECHANICAL INTEGRITY OF INJECTION WELLS,
Davis (Ken E.) Associates, South Bend, IN.
For primary bibliographic entry see Field 7B.
W88-11065

PROCEEDINGS OF THE FOCUS CONFERENCE ON SOUTHEASTERN GROUND WATER ISSUES.
National Water Well Association, Dublin, OH.
For primary bibliographic entry see Field 2F.
W88-11084

EXPERIMENTAL APPROACH TO DETERMINING SUBSURFACE LEAKAGE FROM A SURFACE IMPOUNDMENT USING A RADIOISOTOPE TRACER,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W88-11099

USE OF LIMITED GEOPHYSICAL LOG DATA TO DELINEATE AND CHARACTERIZE DISPOSAL AND CONFINING ZONES,
Davis (Ken E.) Associates, Baton Rouge, LA.
L. A. Gandl, and J. A. Fleniken.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 304-311, 2 fig.

Descriptors: *Disposal wells, *Boreholes heophysics, *Well logs, *Waste disposal, *Liquid wastes, *Geophysics, Geology, Sand, Clays, Central Gulf Coastal Region, Drilling, Wells, Deep wells, Injection wells.

The Gulf Coastal Region of the United States (including Texas, Louisiana and Mississippi) is an area in which potential disposal zones for the deep well injection of liquid wastes are composed predominantly of clastic sediments of Oligocene, Miocene and Pliocene are. In this region, geophysical logs are readily used to delineate formation boundaries as well as to estimate formation characteristics. When new disposal wells are drilled, a full suite of logs is required and many of the formation characteristics of both the disposal zone and the confining zones can be well defined at the site. To define the formation characteristics regionally and within the area of review, area logs of existing wells and old boreholes must be used. The available logs generally consist of any one of a variety of Induction/Resistivity Logs with Spontaneous Potential, and an occasional Gamma Log. These logs are the best tools for defining the formation characteristics and extent within the area of review. Since these logs are exceptional for delineating sand and clay zones, their application in the Gulf Coast clastics is exceptional. (See also W88-11084) (Miller-PTT)
W88-11105

SURFACE-GEOPHYSICAL INVESTIGATIONS AT THE NORTH HOLLYWOOD DUMP, MEMPHIS, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-11107

SURFACE-GEOPHYSICAL INVESTIGATIONS IN MELTON VALLEY, OAK RIDGE RESERVATION, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-11108

SUITABILITY OF GLACIAL GEOLOGY AND HYDROGEOLOGY OF NORTHWEST WASHINGTON FOR SITING WASTE MANAGEMENT FACILITIES,
Brown (K.W.) and Associates, Inc., College Station, TX.
M. Trojan, and G. B. Evans.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 153-163. 4 fig, 1 tab, 3 ref.

Descriptors: *Washington, *Waste disposal, *Waste treatment, *Geological surveys, *Site selection, *Geohydrology, *Geology, *Glacial soils, Environmental effects, Soil texture, Hydraulic conductivity, Hazardous materials, Contamination, Groundwater pollution, Perched groundwater, Drainage systems.

The glacial geology of the northwestern mainland coast of Washington is generally well suited for siting waste disposal, storage, or treatment facilities. The upper glacial drifts and tills consist of very fine grained materials that are densely packed and exhibit low hydraulic conductivities. Although isolated perched saturated conditions exist at the base of the soils and within some coarser packets of the upper glacial deposits, they can be easily controlled via perimeter interceptor drains and below-facility drainage systems. There is essentially no potential for contamination of deeper regional aquifers, for there is no evidence of a hydraulic link (saturated or unsaturated flow) between the upper perched water table(s) and the regional ground water. Typically, a thick unsaturated zone consisting of glacial, fluvial, and/or marine sediments separates the two ground water systems. However, due to the area's geologic complexity, comprehensive hydrogeologic investigations are recommended when siting new waste facilities. (See also W88-11121) (Author's abstract)
W88-11129

GEOLOGIC AND HYDROGEOLOGIC CHARACTERIZATION OF A HAZARDOUS WASTE DISPOSAL SITE, ARLINGTON, OREGON,
Engineering Enterprises, Inc., Long Beach, CA.
S. M. Testa, and F. G. Wolf.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 273-295. 6 fig, 11 ref.

Descriptors: *Hazardous wastes, *Geohydrology, *Geological surveys, *Waste disposal, *Environmental effects, *Hazardous materials, *Water pollution control, Waste dumps, Arid climates, Water table, Infiltration, Geology, Permeability, Leaching, Monitoring, Oregon.

A major hazardous waste disposal facility near Arlington, Oregon serving the Pacific Northwest, Canada, and Alaska maintains numerous favorable environmental characteristics for siting of such a facility including: semi-arid climate, low precipitation, high evapotranspiration, low rate of infiltration, deep water table (uppermost zone of saturation), thick vadose zone, abundant low permeability and moisture deficient soils, low population density, and lack of nearby surface water bodies. The risk of contamination as a result of potential leakage from a waste management unit via primary pathways to surface water, ground water or by direct contact and/or ingestion is thus reasonably low. However, these same characteristics which make the site most suitable for hazardous waste disposal often conflict with demonstration of the ground water monitoring system's ability to adequately perform immediate leak detection as mandated under the Resource Conservation and Recovery Act and the level of demonstration required for the site to be 'properly characterized' may risk the integrity of some of these characteristics. (See also W88-11121) (Author's abstract)
W88-11135

IRRIGATION IMPACT ISSUES AT THE PROPOSED GRANT COUNTY WASTE MANAGEMENT SITE,
Hart Crowser, Inc., Seattle, WA.
C. T. Ellingson.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 569-590. 10 fig, 1 tab, 14 ref.

Descriptors: *Path of pollutants, *Irrigation effects, *Geohydrology, *Environmental effects, *Hazardous wastes, *Waste disposal, *Soil saturation, Confined aquifers, Washington.

Environmental Security Corporation, a Pacific Northwest waste management firm, has proposed to establish a hazardous waste treatment and disposal facility which would include an incinerator and a landfill for disposal of hazardous waste. The proposed site is in central Washington just south of the town of Vantage and just east of the Columbia River. It is located near the western edge of the Columbia Basin Irrigation District which covers some 500,000 acres. Irrigated lands extend to within one mile of the site. Water from the Grand Coulee project and deep wells is applied to nearby fields at a rate which exceeds the evapotranspiration rate. Water has infiltrated and saturated overburden soils and caused head within basalt aquifers to rise. The potential for rising ground water levels and the effect of this rise on the site are major issues with project opponents. The site is located in a rather unique hydrogeologic location with respect to the irrigation impacts. The basalt zone containing the uppermost aquifer outcrops in the ravine above Sand Hollow Creek. This ravine intercepts shallow ground water flow coming from north of the ravine that moves south (down dip) toward the site. The result of the site's location and geologic situation is that there is no saturation of the soils above basalt; that the first saturation is at 150 to 200 feet depth; that ground water levels on-site are quite stable, and that the uppermost aquifer is apparently confined. Ground and surface waters near the site are enriched in nitrates but no herbicides or pesticides were detected. (See also W88-11121) (Author's abstract)
W88-11150

RURAL LANDFILL SITE CHARACTERIZATION, PUBLIC HEALTH ASSESSMENT AND REMEDIAL ACTION, KING COUNTY, WASHINGTON,
Sweet, Edwards and Associates, Inc., Redmond, WA.
J. S. Bailey, and D. P. Lambert.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 609-624. 5 fig, 3 ref.

Descriptors: *Water pollution sources, *Landfills, *Solid waste disposal, *Groundwater pollution, *Cleanup, *Monitoring wells, *Water quality standards, *Public health, Boreholes, Surveys, Organic compounds, Washington.

A solid waste site characterization and ground water monitoring program for a rural landfill site

in King County has been completed. This 51 acre rural site has been in operation since the 1950's and occupies an old sand and gravel borrow pit. The site is underlain by Pleistocene glacial deposits ranging in age from Vashon to Salmon Springs. Twenty three monitoring wells and six solid waste borings were installed, water levels monitored throughout a water year, and selected wells tested to determine hydraulic constants. The monitoring wells were sampled and tested for primary and secondary drinking water standards as well as priority pollutants. Off-site water supply wells within a two mile radius were field located, water levels monitored, and water samples collected and tested. Initial monitoring results showed on-site, and possibly off-site impacts from landfill operations in the shallow aquifer, although primary standards were never exceeded. On-site monitoring wells along the downgradient waste boundary showed low level organic solvent contamination. Further investigation indicated that the solid waste was seasonally saturated within the shallow aquifer and that increases in water quality indicator concentrations correlated with waste saturation. The possibility of off-site impacts indicated a potential public health threat. Therefore, the County immediately replaced shallow downgradient wells with new wells installed into a deeper aquifer. Sampling of the on-site monitoring wells and off-site production wells continued for the remainder of the investigation to evaluate seasonal changes in water quality and assess potential public health risks. Various corrective action alternatives were considered. These included no action; waste removal; hydrologic controls; contaminant capture with partial or full slurry wall and pump back to treatment facility; or combinations of above. Remedial measures were recommended based in part on computer modeling of the hydrology. It was determined that the full slurry wall alternative provided the most reasonable and effective corrective option at reasonable cost. (See also W88-11121) (Author's abstract)
W88-11152

PROCEEDINGS OF THE ASSOCIATION OF GROUND WATER SCIENTISTS AND ENGINEERS SOUTHERN REGIONAL GROUND WATER CONFERENCE.
For primary bibliographic entry see Field 2F.
W88-11182

HYDROGEOLOGIC EVALUATION OF A SANITARY LANDFILL SITE IN KARST TERRAIN OF NORTHWEST ARKANSAS,
Ozark Geological Services, Inc., Fayetteville, AR.
W. M. Goodman.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 88-105, 15 fig, 14 ref.

Descriptors: *Arkansas, *Sanitary landfills, *Site selection, *Karst hydrology, *Aquifers, *Geohydrology, Solid waste disposal, Flow pattern, Artesian flow, Conduits, Perched water.

A 50 acre site in Northwest Arkansas was evaluated for its feasibility as a solid waste isolation site. It occupies a dissected uplands plateau surface located within a recharge area to the shallow bedrock aquifer system, the Boone-St. Joe Limestone Aquifer. The site has been reduced to two basic hydrogeologic components: (1) a thick, residual soil overburden with a thin perched water zone in its base; and (2) a leaky artesian aquifer system in the underlying Boone-St. Joe Limestone Aquifer. Regionally, this aquifer is characteristically unconfined. Beneath the site, interaction of chemically and hydraulically distinct shallow, diffuse and deep, conduit systems promote leaky artesian conditions. Local flow paths are found to be nearly perpendicular to regional flow directions. Although the site is marginal for the applied land use, when put in perspective of the regional setting (severely limited karst terrain) and disposal practices still utilized (area filling in dry karst valleys), location and design are considered progressive. Review of alternative site selections based on hydrologic regimes within the region reveals that better settings are rare when considering the associated topographic, hydrologic and geotechnical factors involved. (See also W88-11182) (Author's abstract)
W88-11188

WASTE MANAGEMENT AND GROUND WATER MONITORING PRACTICES: A COMPARISON OF TECHNIQUES IN THE BEAUMONT FORMATION, TEXAS CITY, TEXAS,
Texas Water Commission, Austin.
P. S. Lewis.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 106-120, 6 fig, 2 tab, 9 ref.

Descriptors: *Network design, *Solid waste disposal, *Water pollution sources, *Waste disposal, *Groundwater pollution, *Monitoring, Waste management, Contamination, Beaumont Formation, Texas, Landfills, Hazardous materials.

In Texas, many waste disposal and treatment sites are located on the Gulf Coastal Plain underlain by sediments of the Beaumont Formation. The Virginia Point - Campbell Bayou area south of Texas City contains numerous waste management units with a variety of treatment and disposal practices. Four units are on 'common ground' for comparison purposes in that a Pleistocene distributary channel sand deposit underlies two impoundments and two land treatment (landfarm) units of contrasting operational history and monitoring techniques. The paleo channel, which is the monitored zone of these units, exhibits the responses of a shallow saturated zone in hydraulic connection to adjacent surface water bodies. Other dynamic influences, such as operator-induced hydraulic loading and groundwater withdrawal, compound the effects of the natural hydrogeologic setting (tidal influences; saltwater intrusion; growth faults; land subsidence) on interpretations of groundwater monitoring data. The four different waste sites of this study have utilized different approaches to monitoring with varying degrees of success. Assessment monitoring has confirmed contamination from both impoundments and its extent has been identified at one site. Operators of landfarm units, monitoring in response to hazardous waste requirements, have had difficulties complying when operators have attempted to satisfy only the minimum regulatory requirements. To design an adequate groundwater monitoring system in this dynamic regime, an owner must consider these operator-induced and natural variabilities. (See also W88-11182) (Author's abstract)
W88-11189

CLASS V INJECTION WELL INVENTORY AND ASSESSMENT, TEXAS,
Texas Water Commission, Austin.
S. F. Musick.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 123-128, 1 tab, 1 ref.

Descriptors: *Texas, *Groundwater pollution, *Injection wells, *Drainage wells, *Disposal wells, *Recharge wells, *Well regulations, Path of pollutants, Geothermal resources, Agricultural drainage, Storm water drainage, Aquifer recharge, Mine backfill, Waste disposal, Underground waste disposal, Legislation, Permits, Regulations.

On Jan. 6, 1982, The Texas Department of Water Resources (now the Texas Water Commission) was granted authority by the U.S. Environmental Protection Agency to administer the Underground Injection Control Program for Class I, III, IV, and V injection wells for the State of Texas. Class V wells are wells which inject fluid exclusive of industrial wastes or oil and gas wastes at shallow depths within the groundwater system. Class V injection wells have been inventoried in Texas, and include wells used for groundwater source heat pumps, agricultural drainage, storm water drainage, aquifer recharge, mine backfill, and disposal of domestic sewage. Assessment of the environmental impact of these injection activities indicates negligible effects on a regional basis, but a potential for local contamination may exist from certain injection activities such as disposal of domestic sewage and agricultural drainage. Class V injection activities are currently authorized by rule, and registration of wells is required. Only domestic sewage disposal of 1,000 gallons per day or greater must be authorized by permit prior to operation. Rules adopted by the Department of Water Resources provide minimum construction standards for all Class V wells. Also, recently passed state legislation requires a licensed water well driller to drill Class V wells. At the federal level, proposed amendments to the Safe Drinking Water Act would require that the U.S. Environmental Protection Agency submit to Congress a national inventory and assessment of Class V wells. Texas, while continuing to update its inventory and assessment, has taken the lead in implementing a comprehensive regulatory program for Class V injection activities. (See also W88-11182) (Author's abstract)
W88-11190

HYDROGEOLOGICAL PROBLEMS ASSOCIATED WITH SITING INJECTION WELLS IN SOUTHERN LOUISIANA,
Underground Resource Management, Inc., Austin, TX.
B. Kent, J. Mikels, and B. Hanson.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 129-144, 3 fig, 17 ref.

Descriptors: *Geohydrology, *Louisiana, *Injection wells, *Disposal wells, *Waste disposal, *Underground waste disposal, *Groundwater pollution, *Path of pollutants, Fate of pollutants, Industrial wastes, Contamination, Environmental effects, Site selection.

Southern Louisiana has the second largest number of industrial injection wells in the U.S. In 1983, the 58 on-site wells and 2 commercial wells in Louisiana injected a total volume of 3.9 billion gallons. Deep well injection has been practiced in southern Louisiana for > 30 years. The disposal of industrial wastes by deep well injection, has been and will continue to be an economic and environmentally sound disposal practice. However, increasing public, legislative, and regulatory pressures dictate that the industry be far more critical and objective in its siting of wells, selection of reservoirs, and methods of operation. In the future, industry will be contending with opposition that has become increasingly familiar with the technical, hydrologic, geologic, and geochemical aspects of deep well injection. Areas that will be points of contention, and which industry must be prepared to address, include demonstration of confinement (spatial and temporal) assurance of injection well and reservoir integrity, demonstration of compatibility of well and reservoir materials with injected fluids, and development of methods of monitoring the fate of the wastes in the subsurface. (See also W88-11182) (Author's abstract)
W88-11191

CONTAMINANT-RESISTANT SLURRY TRENCH,
McBride-Ratcliff and Associates, Houston, TX.
For primary bibliographic entry see Field 5G.
W88-11196

APPLICATION OF MULTIPLE JET PUMPS FOR GROUND WATER RECOVERY,
Kindle, Stone and Associates, Inc., Longview, TX.
For primary bibliographic entry see Field 5G.
W88-11197

EXAMPLE OF THE INFLUENCE OF DEGREE OF CHLORINATION ON SUBSURFACE MIGRATION OF POLYCHLORINATED BIPHENYLS AND RELATED COMPOUNDS,
IT Corp., Houston, TX.
For primary bibliographic entry see Field 5B.

W88-11198

DISPOSAL OF HYDROCARBON CONTAMINATED SOIL,
Applied Earth Sciences, Inc., Houston, TX.
R. A. Ogle.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 459-469.

Descriptors: *Soil contamination, *Waste disposal, *Management planning, *Landfills, *Hydrocarbons, *Environmental management, Economic aspects, Regulation, Risks, Land disposal, Costs, Hazardous materials.

Options are discussed for disposal of hydrocarbon-contaminated soil in landfills. While the paper concentrates on disposal in landfills, most of the comments are equally applicable to landfarm treatment. Of particular interest are the environmental soundness and cost of disposal of hydrocarbon contaminated soil in hazardous versus nonhazardous disposal sites. Disposal of nonhazardous soils in a hazardous waste disposal site is not always the most conservative alternative for limiting potential liability. Disposal in a hazardous waste site may increase liability exposure. In all cases, a careful review of the contaminants in the soil and the applicable regulations can frequently reduce both cost and risks. Greater care to reviewing options available and selection among the available alternatives can result in significant cost savings. (See also W88-11213) (Author's abstract)
W88-11240

SIMULATION OF LEACHATE GENERATION FROM MUNICIPAL SOLID WASTE,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-11263

LOWER JAMES RIVER CIRCULATION STUDY, VIRGINIA, EVALUATION OF CRANEY ISLAND ENLARGEMENT ALTERNATIVES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. B. Heltzel, and M. A. Granat.
Available from the National Technical Information Service, Springfield, VA. 22161, as ADA 194439. Price codes: A04 in paper copy; A01 in microfiche. Technical Report No. HL-88-8, April 1988. Final Report. 67 p, 7 fig, 2 tab, 14 ref, 28 plates, 3 append.

Descriptors: *Hydraulic models, *Mathematical models, *Waste disposal, *Spoil banks, *Dredging, *Craney Island, *Virginia, *Environmental effects, *James River, Estuaries, Water circulation, Hydrodynamics, Model studies.

A numerical model investigation was conducted to assess general changes in circulation, currents, and sedimentation associated with six proposed alternative expansion geometries of the Craney Island confined disposal facility. An additional objective of the study was to assess the effects of each of the six alternative geometries on the reported estuarine circulation cell (flow convergence) off Hampton Flats and Newport News Point. The TAS-2 finite element numerical models, RMA-2V for hydrodynamics, and STUDH for sedimentation were used with a modified version of an existing numerical mesh of the Lower James River. Other information presently available regarding the estuaries circulation and flow convergence observed off Newport News Point and Hampton Flats was reviewed. With the exception of the Newport News Channel, results from the numerical hydrodynamic modeling indicated no plan to base velocity differences greater than + or - 0.06 fps at any of the critical areas of interest. Subtle localized circulation variations, generally within 16,000 ft adjacent to and north and northwest of Craney Island, were identified in based to plan comparison vector plots. Results from the numerical sedimentation modeling showed that plan to base shoaling index values (plan-predicted sedimentation divided by base-predicted sedimentation) were all within 90-110% at the critical areas of interest. (Lantz-PTT)
W88-11280

5F. Water Treatment and Quality Alteration

COPRECIPITATION AND ADSORPTION FOR REMOVAL OF CADMIUM, LEAD, AND ZINC BY THE LIME-SODA ASH WATER SOFTENING PROCESS,
Purdue Univ., Lafayette, IN.
T. K. Chang.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8529266. Ph.D. Dissertation, 1985. 199 p, 104 fig, 28 tab, 111 ref, 2 append.

Descriptors: *Water softening, *Water treatment, *Coprecipitation, *Adsorption, *Crystallization, *Hardness, Cadmium, Zinc, Lead, Calcium carbonate, Calcite, Lime, Heavy metals, Alkalinity.

The lime-soda ash water softening process was applied in the presence of trace amounts of cadmium, and zinc to evaluate the effects of impurities on crystallization kinetics, crystal morphology, and the removal efficiency of hardness. the predominant form of calcium carbonate precipitated in the presence of Cd, Pb, or Zn was calcite; and in the absence of these impurities it was aragonite. Cd and Zn inhibited calcium carbonate crystallization. The major mechanisms involved in the removal of heavy metals from solution in the lime-soda ash water softening process were surface adsorption for Cd and Zn removal and isomorphic inclusion for Ph removal. An initial Cd concentration of 5.0 mg/l caused the residual calcium level to increase by 20 to 30%; calcium removal efficiency improved 5 to 10% in the presence of 1.22 mg/l of lead initially. The highest calcium hardness removal for a continuous flow system was obtained for the slurry recycling system with an initial seeding concentration of 1000 mg/l calcite, operated at pH 10.e in the absence of impurities. The removal of magnesium hardness was not affected by the presence of Cd, Pb, or Zn under mixed suspension mixed product removal (MSMPR) conditions at pH 10.8. When modelled as a MSMPR crystallizer with the population balance theory, the population distribution provides an adequate description of the particle size distribution. (Cremmins-AEPCO)
W88-10096

WASTE DISCHARGE TO LAND AND ITS RELATIONSHIP TO WATER QUALITY IN CALIFORNIA,
California Univ., Los Angeles. Dept. of Environmental Science and Engineering.
J. B. Marshack.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8606469. Ph.D. Dissertation, 1986. 353 p, 26 fig, 91 ref, 6 append.

Descriptors: *Waste disposal, *Wastewater disposal, *Water quality management, *Land disposal, *Pollutants, Groundwater pollution, Soil contamination, Waste identification, Landfills, Cleanup, Administrative regulations, Policy aspects, Policy making.

Seven Central Valley, California sites where waste disposal activities have caused, or have threatened to cause water quality degradation were studied. Deficiencies in construction, operation, or waste acceptance were found at all seven sites, and evidence of contamination migration to underlying soils and groundwater was found at three of them. Liquid waste in surface impoundments and volatile organic contaminants in sanitary landfills were found to present major quality threats. Wastes should be classified using the Designated Level Methodology, in which water quality objectives are selected to provide numerical chemical concentration limits for the protection of the beneficial uses of water that could be affected by waste disposal practices. Soluble and Total Designated Levels are then calculated from these objectives, using factors to represent environmental attenuation and bioavailability. The similarity between chemical constituents of landfilled waste and toxic constituents in the soils of contaminated sites allows the Designated Level Methodology to be applied to the determination of site cleanup levels for the protection of water quality. (Cremmins-AEPCO)
W88-10098

PROCESS FOR RECOVERING AND RECYCLING COAGULANT PRESENT IN WATER TREATMENT SLUDGES,
Environmental Products, Inc., Boca Raton, FL.
For primary bibliographic entry see Field 5D.
W88-10104

ORGANIZATIONAL ALTERNATIVES FOR EXTERNAL SUPPORT IN WATER SUPPLY,
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W88-10112

UPFLOW DIRECT FILTRATION OF HIGH TURBIDITY WATERS,
Tampere Univ. (Finland).
P. Odira, A. Latvala, and M. Viitasaari.
Aqua Fennica AQFEDI, Vol. 17, No. 1, p 59-68, 1987. 12 fig, 1 tab, 9 ref.

Descriptors: *Water treatment, *Direct filtration, *Turbidity, *Filtration, *Sand filters, *Flocculation, Raw water, Particle size, Coagulation.

The use of upflow sand filters in direct filtration of turbid waters is studied with a view toward establishing appropriate media, size and gradation and limitations in scope of operation. The research involved the running of an upflow filter without a separate flocculation unit. Emphasis was also given to the flocculation taking place in the filter. Among the findings of this study were the fact that raw water of clay turbidity up to 80 FTU can be effectively treated by upflow direct filtration. AT optimum coagulant dosage, abrupt changes in influent raw water turbidity up to 180 FTU have little influence on filtrate quality if the changes last for short intervals. Coagulation dosages (alum) above 15 mg/l are undesirable in upflow direct filtration. Such high coagulant dosages result in effluent deterioration due to high aluminium residuals in the filtrate. Depending on influent water turbidity coagulant dosages in the range of 5-15 mg/l have been found adequate. The longest filter runs were generally obtained with 10 mg/l alum dosage. The size graded filter design of best performance in this study is suitable for utilization of filterbed flocculations because the coarse to fine gradation promotes flocculation improvement from the influent to the effluent face. (Friedmann-PTT)
W88-10115

EFFECT OF TEMPERATURE ON WATER TREATMENT,
J. Heinanen.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 201-220, 1987. 17 fig, 11 tab, 68 ref.

Descriptors: *Water treatment, *Temperature effects, Temperature, Water temperature, Water supply, Literature review.

Temperature is a parameter that is often omitted in the design as well as operation of water supplies. However, temperature affects nearly all physical and chemical properties of water and consequently water treatment processes. In most cases, a rise in temperature has a beneficial effect, though not always. For instance, the optimal dosage of chemicals in coagulation-flocculation process usually increases with a rise in temperature and chlorination produces more trihalomethanes, unwanted side products at high temperature. This article is a review of publications concerning the effect of

temperature on water treatment. Among the most important effects of water temperature on water treatment include the fact that lime-softening is easier in higher temperatures; activated carbon is more effective at higher temperature in removal of residual chlorine; solubility of most chemicals in solid form increases with a rise in temperature, lime being the most remarkable exception; solubility of gases decreases with temperature; and the removal of algae is easier in cold water. (Author's abstract)
W88-10123

INFLUENCE OF PRETREATMENT ON THE CAPACITY AND SELECTIVITY OF CLINOPTILOLITE FOR METAL IONS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
M. J. Semmens, and W. P. Martin.
Water Research WATRAG, Vol. 22, No. 5, p 537-542, May 1988. 7 fig, 4 tab, 11 ref.

Descriptors: *Wastewater treatment, *Ion exchange, *Zeolites, *Zeolite process, *Clinoptilolite, *Pretreatment, Selectivity, Capacity, Potassium, Calcium, Sodium, Sodium chloride, Heavy metals, Chemical properties, Ion exchange resins.

Many investigators studying the selectivity of the natural zeolite clinoptilolite for metal ions have noted inconsistencies in measured exchange capacities and selectivity data that appear to be related to how the zeolite was treated prior to testing. In this study the cation composition of a clinoptilolite from the Ash Meadows deposit was characterized after samples were exposed to varying amounts and concentrations of sodium chloride solution. Potassium and calcium ions were strongly held by clinoptilolite in preference to sodium, and extensive exposure to high sodium concentrations was required to displace these ions from the zeolitic matrix. Since these ions are so difficult to displace from the zeolite it is apparent that the sites occupied by potassium and calcium are not readily able to participate in ion exchange. Studies are presented which demonstrate the influence of zeolite cation composition and calcium concentration in solution on the ion exchange performance of clinoptilolite for the removal of certain heavy metals. It is concluded that the zeolite conditioning procedure has an important influence on zeolite performance and it should be determined by the treatment or study objectives. (Author's abstract)
W88-10260

DECOMPOSITION OF TRICHLOROETHYLENE AND TETRACHLOROETHYLENE IN DRINKING WATER BY A COMBINED RADIATION/OZONE TREATMENT,
Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Chemie.
P. Gehringer, E. Proksch, W. Szinovatz, and H. Eschweiler.
Water Research WATRAG, Vol. 22, No. 5, p 645-646, May 1988. 2 fig, 5 ref.

Descriptors: *Water treatment, *Trichloroethylene, *Tetrachloroethylene, *Chlorinated hydrocarbons, *Drinking water, *Ozonation, *Gamma radiation, Radiation, Synergistic effects, Nitrites, Decomposition.

The decomposition of small amounts (100 ppb) of tri- or perchloroethylene in drinking water was investigated. The combined action of gamma-radiation and ozone results in a considerable synergistic effect. In terms of the doses D sub 90 (90% decomposition) necessary to reduce the trichloroethylene concentration to 10 ppb, the synergistic effect causes a reduction in dose from about 122 Gray (for gamma-irradiation) to about 12 Gray for the simultaneous gamma/O3-treatment. For perchloroethylene, the D sub 90 value is reduced from 260 Gray (for gamma irradiation) to about 43 Gray (for gamma/ozone). Furthermore, the presence of ozone eliminates completely the formation of nitrite occurring under gamma-irradiation alone. Additional experiments on the combined action of gamma-irradiation and ozone are planned. (Vernooy-PTT)
W88-10275

COMMUNITY HEALTH EFFECTS OF A MUNICIPAL WATER SUPPLY HYPERFLUORIDATION ACCIDENT,
L. R. Petersen, D. Denis, D. Brown, J. L. Hadler, and S. D. Helgerson.
American Journal of Public Health AJHEAA, Vol. 78, No. 6, p 711-713, June 1988. 2 fig, 1 tab, 17 ref.

Descriptors: *Public health, *Fluoridation, *Hyperfluoridation, *Municipal water, *Accidents, *Drinking water, Plumbing, Water supply, Copper, Acidification, Population exposures, Human diseases.

The public health effects of a municipal water supply hyperfluoridation accident that occurred in a residential Connecticut community are described. For 12 hours, excess hydrofluorosilicic acid was diverted to a 127-home community water supply. Fluoride levels peaked at 51 ppm. Water acidification caused copper to leach from the domestic plumbing and raised copper levels to 25-41 ppm. Fifty-two (33%) of those who drank hyperfluoridated water developed mild gastroenteritis. Vomiting was uncommon and symptom onsets usually occurred more than 30 minutes after drinking the water. This suggests that fluoride rather than copper caused the illness. Skin contact with hyperfluoridated water caused itching and skin rashes. (Author's abstract)
W88-10279

REMOVAL OF AROMATIC NITRO COMPOUNDS FROM WATER BY OZONATION,
Harbin Civil Engineering Inst. (China). Water Pollution Control Lab.
B. Wang, and J. Yin.
Ozone: Science and Engineering OZSEDS, Vol. 10, No. 1, p 1-23, Winter, 1988. 25 fig, 1 tab, 9 ref.

Descriptors: *Ozonation, *Water treatment, *Nitrogen compounds, *Aromatic hydrocarbons, Aromatic compounds, Ozone, Oxidation, Molecular structure, Chemical reactions, Spectroscopy, Mathematical analysis, Mathematical equations, Temperature, Hydrogen ion concentration, Degradation, Nitrites, Kinetics.

Experimental studies were carried out on the removal of five species of aromatic nitro hydrocarbons by ozonation. Ultraviolet spectrograms with distinct absorption peaks were plotted for each of them, and the absorbances of aqueous solutions containing the single compounds increased to different extents at the wave lengths ranging from 200 to 230 nanometers with increase of ozone dosages. This is ascribed to the nitrite ions splitting out of the benzene rings and being further oxidized to nitrate ions by ozonation. The removal of the five species of aromatic nitro compounds by ozonation can be expressed mathematically by first-order reaction equations. The reaction constants and half-life periods for various species of the tested nitro compounds were calculated at different temperatures and pH. An ozonation effect index (OI) was developed to express the degree of degradation of substrates by ozonation, by means of which the five aromatic nitro hydrocarbons were compared with each other and ranked in the following order from greatest to smallest degrees of degradation: p-nitroaniline > nitrobenzene > p-dinitrobenzene > p-nitrotoluene > m-dinitrobenzene. The mechanisms and chemical reactions of removal are discussed. (Author's abstract)
W88-10381

OZONATION OF HUMIC SUBSTANCES: EFFECTS ON MOLECULAR WEIGHT DISTRIBUTIONS OF ORGANIC CARBON AND TRIHALOMETHANE FORMATION POTENTIAL,
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. L. Amy, C. J. Kuo, and R. A. Sierka.
Ozone: Science and Engineering OZSEDS, Vol. 10, No. 1, p 39-54, Winter, 1988. 6 fig, 3 tab, 20 ref.

Descriptors: *Ozonation, *Water treatment, *Humic acids, *Fulvic acids, *Trihalomethanes, *Organic carbon, *Chlorinated hydrocarbons, Carbon, Hydrocarbons, Performance evaluation, Chromatography, Filtration, Ultrafiltration.

Four different sources of humic substances were studied to determine the effects of ozonation on molecular weight distributions, based on dissolved organic carbon (DOC) and trihalomethane formation potential (THMFP). Solutions of two soil-derived fulvic acids and a one soil-derived humic acid, as well as dissolved organic matter (DOM) associated with a natural water source, were studied. Both gel permeation chromatography (GPC) and ultrafiltration (UF) were employed to define apparent molecular weight (AMW). Applied ozone doses ranged from 2.0 to 2.5 mg O3/mg DOC. Overall samples of untreated and ozonated waters, as well as individual molecular weight fractions, were characterized according to DOC, UV absorbance, and THMFP. Ozonation resulted in a significant disappearance of higher AMW material with a corresponding increase in lower AMW material. Although little overall reduction in DOC concentration was observed, significant overall reductions in UV absorbance and THMFP levels were observed. (Author's abstract)
W88-10382

OZONE IN WATER TREATMENT: THE DESIGNER'S ROLE,
Process Applications, Inc., Fort Collins, CO.
R. C. Renner, K. L. Rakness, B. A. Janonis, and D. L. Krenek.
Ozone: Science and Engineering OZSEDS, Vol. 10, No. 1, p 55-87, Winter, 1988. 5 fig, 6 tab, 9 ref.

Descriptors: *Ozonation, *Water treatment, *Water treatment facilities, *Civil engineering, *Design criteria, *Planning, Engineering, Case studies, Taste, Odor, Organoleptic properties, Water quality management, Cost analysis, Process control, Specifications, Hydraulics, Economic aspects, Ozone, Optimization, Performance evaluation, Colorado.

The designer's role in providing an efficient and reliable ozone system for use in water treatment is described. The 5 mgd regional water plant in Avon, Colorado is used as a case study. Two alternatives were evaluated in process design; the ozone alternative was selected based on its multiple benefits. These benefits included iron and manganese removal, taste and odor control, coagulation, and disinfection. Each aspect of the ozone system design is reviewed. The following recommendations are made: (1) pilot plant testing should be conducted to help determine the effectiveness of ozone and to establish dosage; (2) the engineer should take an active role in designing and specifying the system; (3) key elements to be addressed include quantity of dessicant, the capacity and number of air compressors and ozone generators, efficient contacting, and appropriate controls and instrumentation; and (4) the system should be supplied by one manufacturer who has the responsibility for coordinating all the equipment. It is concluded that, despite their past reputation for poor performance, ozone systems can provide very reliable and cost-effective service when properly designed. (Doria-PTT)
W88-10383

CHEMICAL REACTIONS OF OZONE AND THEIR ROLE IN DEVELOPING IMPROVED ANALYTICAL METHODS,
Miami Univ., Oxford, OH. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-10384

COMBINATION OF OZONE/HYDROGEN PEROXIDE AND OZONE/UV RADIATION FOR REDUCTION OF TRIHALOMETHANE FORMATION POTENTIAL IN SURFACE WATER,
Louisiana Tech Univ., Ruston. Dept. of Chemical Engineering.
J. L. Wallace, B. Vahadi, J. B. Fernandes, and B. H. Boyden.
Ozone: Science and Engineering OZSEDS, Vol. 10, No. 1, p 103-112, Winter, 1988. 4 fig, 3 tab, 8 ref. Louisiana Board of Regents Grant No. 81-LAT/002- B26.

Descriptors: *Ozone, *Ozonation, *Water treatment, *Ultraviolet radiation, *Oxidation, *Trihalomethanes, *Hydrocarbons, *Chlorinated hydrocarbons, Radiation, Performance evaluation, Chemical reactions, Surface water, Chemical analysis, Water analysis, Lakes, Drinking water, Water quality management, Hydrogen peroxide, Louisiana.

Settled, filtered surface water with a high trihalomethane formation potential (THMFP) was oxidized by combinations of ozone, hydrogen peroxide, and ultraviolet irradiation to determine the dosages required to accomplish significant reductions in THMFP. Applied ozone dosages of 20, 25, and 30 mg/L to lake water utilized by the city of Shreveport, Louisiana, produced no significant reductions in THMFP. However, the addition of 20 mg/L of hydrogen peroxide and/or 0.67 W/L of UV radiation (254 nm) in combination with ozone produced decreases in THMFP of more than 60% in 60 minutes. Smaller THMFP decreases were seen with shorter contact times. The use of H2O2 and/or UV in combination with O3 increased the percentage of applied ozone consumed by the lake water (i.e., enhanced the ozone mass transfer) five times over simple ozonation. (Author's abstract)
W88-10385

OZONE CONCENTRATION AND TEMPERATURE EFFECTS ON DISINFECTION KINETICS,
Battelle Memorial Inst., Columbus, OH. Environmental and Health Sciences Section.
G. B. Wickramanayake, and O. J. Sproul.
Ozone: Science and Engineering OZSEDS, Vol. 10, No. 2, p 123-135, Spring, 1988. 6 fig, 3 tab, 9 ref. EPA Grant R808150-02-0.

Descriptors: *Ozone, *Temperature effects, *Kinetics, *Disinfection, *Water treatment, *Ozonation, Process control, Aquatic animals, Protozoan, Survival, Mathematical equations, Viruses.

The effects of contact time, ozone level, and temperature on the extent of ozone inactivation of cysts of the nonpathogenic soil and water ameba Naegleria gruberi were studied. Cysts were inactivated using aqueous ozone in batch reactors at controlled temperatures (5-30 C) at pH 7. The semi-log plots of survival ratio vs. time consisted of an initial shoulder followed by a linear portion. The log-log plots of ozone concentration against time for 99% inactivation were essentially linear. The relationship between the overall inactivation rate and absolute temperature was well expressed by the Arrhenius theory. An empirical relationship was developed between the extent of cyst inactivation, ozone dose, temperature, and contact time. The inactivation rate constant for N. gruberi cysts was about three orders of magnitude less than that for poliovirus I, indicating that the cysts are highly resistant compared to the virus. (Author's abstract)
W88-10386

INTERACTIONS BETWEEN OZONE, HALOGENS AND ORGANIC COMPOUNDS,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
M. Dore, N. Merlet, B. Legube, and J. P. Croue.
Ozone: Science and Engineering OZSEDS, Vol. 10, No. 2, p 153-172, Spring, 1988. 20 fig, 2 tab, 19 ref.

Descriptors: *Chlorinated hydrocarbons, *Halogens, *Organic compounds, *Water treatment, *Ozonation, Chlorine, Ammonia, Bromides, Salts, Fulvic acids, Chemical reactions, Ozone, Oxidation, Acids, Inorganic acids, Trihalomethanes, Organic acids, Bicarbonates.

The interactions between ozone, halogens, and organic compounds during drinking water treatment are discussed. Experiments conducted on simple organic compounds or on natural fulvic acids show important decreases in trihalomethane or trichloroacetic acid formation after ozonation, although ozonation of surface waters may induce the formation of haloform precursors, usually with a low level of reactivity. In water supplies containing bromide ions, oxidation of the latter through hypobromous acid may occur during the ozonation stage. In the absence of preozonation, hypobromous acid is generated very rapidly during chlorination, thus inducing the formation of chlorobrominated organic compounds. During the ozonation of fulvic acid solutions, the presence of small amounts of bicarbonate was found to improve precursor removal significantly. It is concluded that the consequence of preozonation is the destruction, at least in part, of the most reactive sites for trihalomethane production, thus leading to a decrease of the volatile organochlorinated compounds formed during the post-chlorination. However, some ozonation products of natural waters are trihalomethane precursors; thus, in the presence of bromide ions, the formation of volatile organobrominated compounds may be observed during ozonation. (Author's abstract)
W88-10387

PRACTICAL DESIGN MODEL FOR CALCULATING BUBBLE DIFFUSER CONTACTOR OZONE TRANSFER EFFICIENCY,
Process Applications, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 5D.
W88-10388

WATER NITRATES AND CNS BIRTH DEFECTS: A POPULATION-BASED CASE-CONTROL STUDY,
Toronto Univ. (Ontario). Dept. of Preventive Medicine and Biostatistics.
For primary bibliographic entry see Field 5C.
W88-10390

BLADDER CANCER IN MASSACHUSETTS RELATED TO CHLORINATED AND CHLORAMINATED DRINKING WATER: A CASE-CONTROL STUDY,
Brown Univ., Providence, RI. Dept. of Community Health.
For primary bibliographic entry see Field 5C.
W88-10392

LAMELLA SETTLERS: MATERIAL BALANCES AND CLARIFICATION RATES,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5D.
W88-10407

AQUIFER RESTORATION: CHLORINATED ORGANICS REMOVAL CONSIDERATIONS IN PROVEN VS INNOVATIVE TECHNOLOGIES,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5G.
W88-10408

CATALYTIC OXIDATION OF GROUNDWATER STRIPPING EMISSIONS,
Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
For primary bibliographic entry see Field 5G.
W88-10409

CURRENT RESTATEMENT AND CONTINUING REAPPRAISAL CONCERNING DEMOGRAPHIC VARIABLES IN AMERICAN TIME-TREND STUDIES ON WATER FLUORIDATION AND HUMAN CANCER,
J. R. Graham, D. Burk, and P. Morin.
Proceedings of the Pennsylvania Academy of Science PPASAK, Vol. 61, No. 2, p 138-146, 1987. 2 fig, 5 tab, 23 ref.

Descriptors: *Statistical analysis, *Human diseases, *Population exposure, *Time series analysis, *Fluoridation, *United States, *Human populations, *Water treatment, *Drinking water, Cancer, Demographics.

The association between artificial fluoridation of public water supplies and increased crude cancer death rates in large central cities of the United States from 1940 through 1968 are reviewed. Although critics believe that association is explained away by demographic changes in the two groups of central cities being compared, the authors believe that there is a casual relationship between water fluoridation and human cancer. Major papers of these critics are evaluated and it is shown that if all available and pertinent data are standardized by the indirect method for age, race, and sex, the association remains substantially intact but somewhat reduced. Attention is also given to a recent suggestion that the association can be explained by changes in population sizes of the twenty cities observed. Analysis of this proposal reveals that, in the cities considered during the period observed, changes in population size were essentially an inverse index of population aging and yielded adjustments parallel to those for age, race and sex. It is concluded that artificial fluoridation appears to cause or induce about 20-30 excess cancer deaths for every 100,000 persons exposed per year after about 15-20 years. (Author's abstract)
W88-10513

PURGEABLE ORGANICS IN GREAT LAKES RAW AND TREATED WATER,
Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W88-10530

MOLECULAR MECHANISMS OF VIRAL INACTIVATION BY WATER DISINFECTANTS,
Arizona Univ., Tucson. Dept. of Microbiology.
R. B. Thurman, and C. P. Gerba.
Advances in Applied Microbiology ADAMAP, Vol. 33, p 75-105, 1988. 8 fig, 141 ref.

Descriptors: *Viruses, *Disinfection, *Water treatment, *Chlorination, *Chemical treatment, Water quality control, Water quality, Ribonucleic acid, Proteins, Public health.

A suggestion made by Tifft of using two-stage disinfection may offer an efficient means of inactivation of viruses. Initial treatment using chlorine followed by chlorine dioxide is vastly superior to single-stage disinfection. Taylor stated that iodine increases viral permeability by reacting with the capsid proteins, while chlorine dioxide attacks an internal target. In the two-stage approach to disinfection an initial attack of capsid proteins alters the structural integrity of the virus. Second-stage disinfectants, which normally would be unable to diffuse across the intact viral capsid, are then able to reach their target sites easily and inactivate the RNA, reducing the likelihood of multiplicity reactivation. Greater rates of inactivation of viruses with lower concentrations of chemical disinfectants have been achieved. The literature to date seems contradictory in describing the action of various disinfectants on different virus types. It is, important to remember that the experimental conditions are not uniform from one investigation to the next and that many factors influence the outcome and interpretation of data. No single disinfectant is equally effective under all conditions for all viruses. (Alexander-PTT)
W88-10741

BACTERIOPHAGES AS MODEL ORGANISMS IN WATER TREATMENT,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
A. H. Havelaar.
Microbiological Sciences, Vol. 4, No. 12, p 362-364, December 1987. 1 fig, 3 tab, 22 ref.

Descriptors: *Viruses, *Disinfection, *Bacteriophages, *Bioindicators, *Wastewater pollution, *Water treatment, *Microbiological studies, *Water quality, Analytical methods, Pollutant identification, Water quality control, Wastewater, Sewage, Coliforms, Performacne evaluation.

On the basis of published information and the experimental work summarized, it may be concluded that F-specific RNA bacteriophages are suitable indicator organisms in the study of virus inactiva-

tion in many water treatment processes. They can be enumerated by simple, inexpensive yet accurate methods and results may be available within 6-8 h. They are abundantly present in sewage and sewage-polluted waters and are considerably more resistant towards inactivation than the traditional fecal bacteria (E. coli, fecal streptococci). Their resistance appears to parallel or slightly exceed that of culturable enteric viruses. Definitive conclusions can be drawn only after direct comparison with the hepatitis and gastro-enteritis viruses, which are not yet culturable from water. The significance of FRNA-phages as index organisms for viral pollution is not clear at present. They are not of fecal origin as the human viruses are, so there will not be a perfect correlation. The presence of FRNA-phages in a water sample appears rather to be an index of sewage contamination, and this also makes them a valuable tool for the assessment of water quality. (Alexander-PTT)
W88-10744

MEMBRANE DISTILLATION IN THE TREATMENT OF AQUEOUS SOLUTIONS,
Naples Univ. (Italy). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W88-10761

CALCULATING EQUITY-NEUTRAL WATER AND SEWER IMPACT FEES,
University of Southern California, Los Angeles. School of Urban and Regional Planning.
For primary bibliographic entry see Field 6C.
W88-10790

OZONE: PRIMARY DISINFECTION CHOICE FOR TUCSON,
B. W. Long, J. S. Heckler, and D. F. Johnson.
Water Engineering and Management WENMD2, Vol. 135, No. 5, p 32-34 and 38, May 1988. 1 fig.

Descriptors: *Ozone, *Disinfection, *Water treatment, *Arizona, *Tucson, Methane, Design criteria, Trihalomethanes, Organoleptic properties, Odor control, Taste.

Tucson's year-long water pilot plant testing program was undertaken to develop design criteria for a 150 mgd water treatment plant which will treat Central Arizona Project water. The use of ozone in the water treatment was a principal factor to be evaluated in the pilot plant program. Particular areas of study included: (1) the use of ozone as a microcoagulant, (2) the influence of ozone on trihalomethane formation, (3) the use of ozone as a pre-disinfectant, (4) the effectiveness of ozone eliminating or effectively altering the taste and odor characteristics of finished water, (5) ozone mass transfer efficiencies using different contactor designs, and (6) the comparative benefits realized from alternate points of ozone addition, as well as for single versus multiple points of ozone addition. The use of ozone in treating Central Arizona Project water provided numerous benefits, the summation of which resulted in the inclusion of ozonation in the design for Tucson's new water treatment plant. Applying ozone at a dosage between 1.5 and 3.0 mg/l preceding coagulation produced the following benefits: (1) serves as the primary disinfectant, more than satisfying requirements set forth in EPA's proposed surface water requirements, (2) lowers finished water turbidities attainable at reduced dosages of coagulant aid which also results in 20 to 30% increases in filter productivity, (3) substantially reduces the level of trihalomethanes formed during a two-hour exposure period to free chlorine, (4) improves the finished water taste and odor characteristics, and (5) increases treatment process flexibilty when responding to changes in raw water quality. (Miller-PTT)
W88-10791

TREATING WATER WITH PEROXONE: A REVOLUTION IN THE MAKING,
Southern California Metropolitan Water District, Los Angeles.
M. J. McGuire, and M. K. Davis.
Water Engineering and Management WENMD2, Vol. 135, No. 5, p 42, 45-46, 48-49, May 1988. 2 fig, 3 tab, 6 ref.

Descriptors: *Water treatment, *Peroxone, *Chloramines, *Disinfection, *Ozone, *Methane, Trihalomethanes, Drinking water, Hydrogen peroxide, Pilot plants, Odor control, Organoleptic properties.

Peroxone, or the combination of hydrogen peroxide and ozone, appears to hold great promise for solving disinfection by-products (including trihalomethanes) and microbiological problems at many water utilities at up to half the cost of ozone alone. The Metropolitan Water District of Southern California performed a full-scale test of the effect of ozone and chloramines on its state project water supply using the Los Angeles Department of Water and Power ozone direct filtration plant. At applied ozone dosages of up to 4 mg/l, and subsequent laboratory additions of chloramines at 1.5 mg/l, trihalomethane concentrations at 1 microg/l or less were produced after five days of incubation at 25 C. The combination of ozone and chloramine is attractive because it would solve both disinfection and trihalomethane problems. The effect of ozone and advanced oxidation processes, including H2O2 and O3, on odorous compounds was studied at UCLA and it was shown that many organic compounds can be removed. In parallel to the work at UCLA, a major research effort to test the ability of peroxone to control groundwater contaminants, such as trichloroethylene and perchloroethylene, was also undertaken. Both bench- and pilot-scale data demonstrated that the Peroxone process is much faster and more efficient than ozone alone for removing common groundwater contaminants. It is concluded that the use of ozone followed by chloramines as a means of controlling the formation of dozens of chlorinated disinfection by-products deserves the attention of the water utility industry. (Miller-PTT)
W88-10792

CHILDHOOD MORTALITY IN RELATION TO NUTRITIONAL STATUS AND WATER SUPPLY: A PROSPECTIVE STUDY FROM RURAL MALAWI,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
U. Lindskog, P. Lindskog, J. Carstensen, Y. Larsson, and M. Gebre-Medhin.
Acta Paediatrica Scandinavica, Vol. 77, No. 2, p 260-268, March 1988. 3 fig, 3 tab, 32 ref.

Descriptors: *Public health, *Nutrition, *Mortality, *Water supply, *Drinking water, Morbidity, Statistical analysis, Seasonal variations, Children, Human pathology, Human physiology, Potable water, Public water, Malawi.

In connection with the introduction of an improved method of water supply in rural Malawi, the nutritional status, morbidity, and mortality among 1178 children under five were studied during three rainy and three dry seasons. Data were collected at fortnightly home interviews. Nutritional assessment was made twice a year. one hundred and thirty-seven of the children died during the study period, and the probability of dying before the age of five was estimated to 270 per 1,000 children. The mortality risk was related to weight for height ($p < 0.001$) and height for age ($p < 0.01$) as well as to upper arm circumference ($p < 0.001$) and triceps skinfold ($p < 0.05$). Mortality among children living in households using the new, piped-water supply tended to be lower than mortality for those using traditional water sources, although the difference was not statistically significant (relative risk 0.4, 95% confidence interval 0.1-1.3). (Author's abstract)
W88-10842

EXAMINATION OF SURFACE WATERS USED A SOURCES OF SUPPLY IN THE PORT HARCOURT AREA: II. CHEMICAL HYDROLOGY,
Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria). Microbiology Div.
M. T. Ogan.
Archiv fuer Hydrobiologie, Supplement 79, No. 2/3, p 325-342, February 1988. 1 fig, 5 tab, 52 ref. University of Port Harcourt Senate Research Grant UPH/REG/COM.5.4.

Descriptors: *Pollutant identification, *Rivers, *Streams, *Surface water, *Chemical composition, *Water quality, Chemical properties, Water pollution, Domestic water, Calcium, Magnesium, Iron, Zinc, Copper, Sodium, Potassium, Phosphorus, Nitrates, Nitrites, Sulfates, Ammonia, Organic acids, Organic compounds, Carbohydrates, Hardness, Turbidity, Hydrogen ion composition, Biological oxygen demand, Macrophytes, Phytoplankton.

The chemical hydrology of some shallow rivers and streams used as sources of water supply in Port Harcourt were determined at 10 stations. The range of the mean concentrations of cations was 0.03-0.84 mg/l, with extremes for individual ions as follows: Ca, 0.20-0.65; Mg, 0.11-2.30; K, 0.30-1.90; Na, 0/44-1.88; Fe, 0.17-0.83; Cu, 0.01-0.07; Zn, 0.01-0.07. The sum Ca + Mg + Na + K, varied between 1.5 and 4.53 mg/l. Values at 7 stations were all <2.0 mg/l. The commonest cation dominance pattern at 5 stations was K>Na>Ca>Mg, but the overall pattern was in the order K>Na>Mg>Ca. Extreme values of some indices of pollution were pH (5.6-6.0), Biochemical Oxygen Demand (BOD) (0.15-0.92 mg/l), total hardness (0.01-0.25 mg/l), turbidity (0.01-3.1 units), total residues (660-900 mg/l), non-filtrable residue (9-37.20 mg/l). Phosphorus, nitrate, nitrite, ammonia, and sulfate were all in the range 0.01-0.43 mg/l represented by the extreme for nitrite. Nitrite and nitrate were mostly <0.1 mg/l; phosphorus and sulfate were mostly <0.20 mg/l. Total soluble carbohydrates and organic acids ranged from 0-70 mg/l and 1.0-4.0 mg/l respectively. Significant and strong correlations were obtained as follows: pH:NO3 ($r=0.7920$, $p<or=0.01$); turbidity:residue ($r=0.9436$, $p<or=0.001$); turbidity:NO2 ($r=0.9791$, $p<or=0.001$); total hardness:carbohydrates ($r=0.6092$, $p<or=0.05$); PO4:NH4 ($r=0.7570$, $p<or=0.01$); NO2:NH4 ($r=0.6099$, $p<or=0.05$). Differences in concentration of Ca, K, Na, Fe, PO4, NH4 and NO3 between in-mat and margin water were obtained in relation to Panicum brevifolium, Nymphaea lotus and Azolla sp., but showed no definite pattern. These waters are considered to have qualities superior to other Nigerian rivers for which data are available. (Author's abstract)
W88-10891

OPTIMUM STRENGTHENING OF DRINKING WATER SUPPLY NETWORKS IN RURAL AREAS: PRELIMINARY PROJECT METHODS (RENFORCEMENT OPTIMUM DES RESEAUX D'ADDUCTION D'EAU POTABLE EN ZONE RURALE METHODES D'AVANT-PROJET),
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Cestas Principal (France). Div. Hydraulique Agricole.
P. Bourgine, and B. Bremond.
La Houille Blanche, No. 1, p 25-44, 1988. 8 fig, 22 ref. English summary.

Descriptors: *Project planning, *Drinking water, *Water supply, *Water conveyance, Costs, Economic aspects, Pipelines, Pipe flow, Pressure, Hydraulics, Rural areas, Mathematical analysis.

The expansion of drinking water supply networks is carried out to satisfy certain constraints, namely delivery at a given point of a certain flow within prescribed pressure limits. If the marginal costs or dual variables of these constraints (e.g cost of an additional cubic meter per second or meter of pressure at any given point) are known during preliminary studies, the economic aspects of the project can be assessed better and useful modifications made. The relationship between dual variables was established using the assumption that the range of pipe diameters is continuous. It is shown that dual variables of flow behave like a potential and that dual variables of pressure behave like a flow. For a given set of constraints, optimal expansion is obtained by superimposition of no-looped elements on an existing looped network. The cost of expansion as well as that of the constraints and their derivatives can be expressed analytically as a

function of hydraulic head variables. A gradient method leads to a means of expansion which is locally optimal; the resulting dual variables allow calculation of the marginal costs of flow and pressure. This method can be used with multi-source systems and is particularly suitable for networks in which transport is a more important factor than distribution and where pipe-laying costs are predictable. (Author's abstract)
W88-10905

NUMERICAL MODELING OF REGIONAL GROUNDWATER POLLUTION BY TETRACHLOROETHYLENE,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5B.
W88-10964

MODELING MICROBIAL FOULING IN POROUS MEDIA,
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
For primary bibliographic entry see Field 2F.
W88-10976

FINDING WATER: A GUIDE TO THE CONSTRUCTION AND MAINTENANCE OF PRIVATE WATER SUPPLIES,
R. Brassington.
Pelham Books, London, England. 1983. 184p.

Descriptors: *Water supply development, *Water treatment, *Water supply, *Europe, Water quality, Water law, Available water, Maintenance.

This is a practical guide for all those people whose property, for one reason or another, cannot be connected to mains water and therefore needs its own water supply. The author examines where the water comes from, who needs a private water supply, how much water is available and how to get the right amount from a source. There are also chapters on building new sources, water quality and treatment, water rights and the law, together with advice on which jobs can be tackled by non-specialists, when to call in the experts and how to maintain a water system once it is installed. (Lantz-PTT)
W88-11029

CERTIFICATION OF LOCAL LABORATORIES ANALYZING DRINKING WATER IN NONPRIMACY STATES,
Environmental Protection Agency, Denver, CO. Region VIII.
For primary bibliographic entry see Field 5A.
W88-11164

HEALTH ASPECTS OF EUTROPHICATION,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5C.
W88-11270

PHOTOVOLTAIC WATER PUMPING FOR BOLIVIA,
Sandia National Labs., Albuquerque, NM.
For primary bibliographic entry see Field 4B.
W88-11274

5G. Water Quality Control

ONCHOCERCIASIS CONTROL PROGRAMME IN WEST AFRICA: TEN YEARS MONITORING OF FISH POPULATIONS,
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 4C.
W88-10141

PHOSPHORUS INACTIVATION IN A EUTROPHIC LAKE BY THE DIRECT ADDITION OF FERRIC ALUMINIUM SULPHATE: CHANGES IN PHYTOPLANKTON POPULATIONS,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
For primary bibliographic entry see Field 2H.
W88-10208

ALGORITHM FOR SELECTIVE WITHDRAWAL FROM STRATIFIED RESERVOIR,
Western Australia Univ., Nedlands. Centre for Water Research.
For primary bibliographic entry see Field 4A.
W88-10228

NEUTRALIZING STRATEGIES FOR ACID WATERS: SODIUM AND CALCIUM PRODUCTS GENERATE DIFFERENT ACID NEUTRALIZING CAPACITIES,
Freshwater Biological Association, Windermere (England).
W. Davison, and W. A. House.
Water Research WATRAG, Vol. 22, No. 5, p 577-583, May 1988. 5 fig, 3 tab, 21 ref.

Descriptors: *Water pollution treatment, *Neutralization, *Acidic water, *Calcium, *Acid neutralizing capacity, Chemical treatment, Computer models, Sodium, Alkalinity, Equilibrium, Calcite, Calcium carbonate, Calcium hydroxide, Sodium hydroxide, Sodium carbonate, Mathematical models, Cost analysis, Hydrogen ion concentration.

A computer model was developed to calculate the final alkalinity of waters at equilibrium with air and solid phase calcite, after neutralization by a sodium or calcium-based product. Results are presented for waters of various initial composition, with the initial concentration of calcium varying from 0.01 to 10 mmol/cu dm and the initial pH from 2 to 6. Waters which were initially very acid, and deficient in calcium, could sustain a much higher final alkalinity, a measure of the water's resistance to further supply of acid, if they were neutralized by either sodium hydroxide or sodium carbonate rather than calcium hydroxide or calcium carbonate. Soft waters acidified by acid rain, and acid mine waters low in calcium, would benefit most from using sodium-based neutralizing agents. The higher cost of sodium products is offset by their greater solubility and ease of application. (Author's abstract)
W88-10266

FILTERING UNIT FOR THE REMOVAL OF PESTICIDE RESIDUES FROM AQUEOUS SOLUTIONS,
Stazione Sperimentale Agraria Forestale, Trento (Italy).
G. Toller, and G. M. Flaim.
Water Research WATRAG, Vol. 22, No. 5, p 657-661, May 1988. 1 fig, 5 tab, 6 ref.

Descriptors: *Filtration, *Wastewater facilities, *Water pollution control, *Tank cleaning, *Pesticide residues, Water pollution sources, Path of pollutants, Pilot plants, Spraying, Pesticides, Bioassay, Daphnia, Gloeosporium, Peat, Mosses, Manure, Wastewater treatment, Fruit crops, Apples.

Pesticide loss during filling and washing spray tanks can be considerable, especially where cooperative pesticide distribution centers exist (up to 200 1000-liter tanks daily). A filtering unit using readily available organic media (peat, moss, and manure) was designed to filter out a variety of commonly-used pesticides in apple orchards. Each filtering unit received residues from 20 pesticide applications consisting of a typical pesticide treatment schedule for apples. Initial concentration of the pesticides in wastewater was between 26 and 1820 mg/l. Average removal efficiencies were >99% for dodine, copper oxychloride, azinphos methyl, triadimefon, bitertanol, dithianon, fenarimol, chlorpyrifos ethyl, cyhexatin, benzomate, dinocap, and benomyl. Removal efficiency for vamidothion averaged 61%; removal for sulfur was 73%. Bioassays with Daphnia magna and Gloeosporium sp. were performed to evaluate effluent toxicity. (Author's abstract)
W88-10278

ENVIRONMENTAL PROTECTION IN THE UNITED STATES PULP, PAPER, AND PAPERBOARD INDUSTRY: AN OVERVIEW OF REGULATION OF WASTEWATER UNDER THE U.S. CLEAN WATER ACT,
Environmental Protection Agency, Washington, DC. Office of the Assistant Administrator for Water.
R. W. Hanmer.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 1-7, 1988.

Descriptors: *Environmental protection, *Pulp and paper industry, *United States, *Water pollution control, *Regulations, *Clean Water Act, Wastewater, Permits, Protection, Administrative regulations, Industrial wastewater, Wastes, Industrial wastes, Pulp wastes, Reviews, Legal aspects, Water quality management, Sludge disposal, Technology, Standards, Water quality standards.

The pulp, paper, and paperboard industry in the United States is the largest industrial user of water, with half of the facilities discharging wastewater directly. The major pollutants of concern have historically been the conventional pollutants: biochemical oxygen demand (BOD5), total suspended solids (TSS), and pH. Biological treatment systems are currently employed to reduce these pollutants. Sludges generated by these treatment systems have been categorized as nonhazardous and are generally landfilled. Under the Clean Water Act, the Environmental Protection Agency (EPA) has promulgated all the required regulations for this industry. The national regulations are applied to individual pulp and paper mills through permits issued by EPA Regional or State staff. Permit limits can be written that are more restrictive than the national regulations to protect local water quality. In its current projects concerning the pulp and paper industry, EPA is focusing on the reduction of toxic pollutants. The Agency is conducting a joint EPA/industry program to study dioxin discharges at bleached kraft mills. The Agency will also undertake a comprehensive review of the pulp and paper regulations in 1988. (Author's abstract)
W88-10309

REQUIREMENTS FOR THE TREATMENT OF EFFLUENTS FROM CHEMICAL PULP MILLS IN THE F.R.G.,
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W88-10311

WATER POLLUTION ABATEMENT IN SMALL PAPER MILLS IN INDIA,
National Productivity Council, New Delhi (India).
For primary bibliographic entry see Field 5D.
W88-10313

NEW IDEAS ON POLLUTION CONTROL IN THE PULP AND PAPER INDUSTRY--ARE THERE ANY,
Confederation of Finnish Industries, Helsinki.
O. Airanne, and S. Ruonala.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 207-210, 1988. 1 fig.

Descriptors: *Pulp and paper industry, *Environmental protection, *Water pollution control, *Wastewater treatment, *Water quality management, *Environmental policy, Protection, Reviews, Energy, Technology, Decision making.

The development of the pulp and paper industry is reviewed from the standpoint of environmental protection, and the difficulties of defining the total harmful effects of a process are outlined. Current pulp production processes have not changed markedly over 100 years, creating the challenge of creating entirely new processes that use less raw materials and energy and create less pollution. Treatment of effluents often increases pollution instead of reducing it. This demands a careful and comprehensive analysis of environmental effects as a basis for selecting alternatives. It is concluded that the goals and objectives of environmental

protection are matters of human decision making that require all available relevant information. Future choices must be made to allocate scarce resources so that output in terms of environmental quality is maximized. (Author's abstract)
W88-10331

RESTORATION OF SHALLOW LAKE ECOSYSTEMS, WITH EMPHASIS ON LOOSDRECHT LAKES,
Ministerie van Volkshuisvesting en Ruimtelijke Ordening, Leidschendam (Netherlands).
H. W. Kroes.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 5-7, November, 1986. 2 ref.

Descriptors: *Lake restoration, *Water pollution effects, *Eutrophication, *Netherlands, *Loosdrecht Lakes, *Lakes, Aquatic environment, Shallow water, Resources management, Reviews, Ecology, Environment, Stratification, Thermal stratification, Physical properties, Productivity, Primary productivity, Environmental effects, Conferences, Symposium, Peat, Nutrients, Trophic level.

The problem of eutrophication in shallow lakes is reviewed as an introduction to a symposium emphasizing the Loosdrecht Lakes of The Netherlands. The ecological and chemical characteristics of shallow lakes are discussed. The Loosdrecht Lakes originated centuries ago as the result of the excavation for peat. For the past 20 or 30 years, they have undergone rapid deterioration as a consequence of a tremendous increase in the inflow of phosphorus compounds. Government attempts to reduce phosphate loads of surface waters from all important sources have met with little success. However, the Water Quality Research Loosdrecht Lakes (WQL) project, funded partly by the government and partly by other institutions, is the expression of a serious wish not only to do research, but also to contribute to a practical solution of the eutrophication problem in this region. (See also W88-10342 thru W88-10354 and W88-10359) (Doria-PTT)
W88-10341

LOOSDRECHT LAKES, ORIGIN, EUTROPHICATION, RESTORATION AND RESEARCH PROGRAMME,
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W88-10342

BIOMANIPULATION AND ITS FEASIBILITY FOR WATER QUALITY MANAGEMENT IN SHALLOW EUTROPHIC WATER BODIES IN THE NETHERLANDS,
Limnologisch Inst., Oosterzee (Netherlands).
For primary bibliographic entry see Field 2H.
W88-10355

PRELIMINARY RESULTS ON PHOSPHORUS REDUCTION IN LOUGH NEAGH: ASSESSING THE EFFECT AGAINST A BACKGROUND OF CHANGE,
Department of Agriculture for Northern Ireland, Belfast.
For primary bibliographic entry see Field 2H.
W88-10356

CONTROL OF PHOSPHORUS LOADING AND FLUSHING AS RESTORATION METHODS FOR LAKE VELUWE, THE NETHERLANDS,
Ministry of Transport and Public Works, Lelystad (Netherlands).
For primary bibliographic entry see Field 2H.
W88-10357

MODELLING THE RECOVERY OF HYPERTROPHIC L. GLUMSO (DENMARK),
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 2H.
W88-10361

IDENTIFICATION AND QUANTIFICATION OF VOLATILE ORGANIC SPECIES DURING MICROBIAL TREATMENT OF LEACHATE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5D.
W88-10405

AQUIFER RESTORATION: CHLORINATED ORGANICS REMOVAL CONSIDERATIONS IN PROVEN VS INNOVATIVE TECHNOLOGIES,
Weston (Roy F.), Inc., West Chester, PA.
D. Dworkin, and M. W. Cawley.
Environmental Progress ENVPDI, Vol. 7, No. 2, p 99-103, May 1988. 4 fig, 6 tab, 8 ref.

Descriptors: *Chlorinated hydrocarbons, *Groundwater pollution, *Activated carbon, *Air stripping, *Water pollution treatment, *Aquifer restoration, Hydrocarbons, Water pollution, Water treatment, Biological treatment, Carbon, Adsorption, Cost analysis, Costs, Capital costs, Maintenance costs, Operating costs, Biodegradation, Microbial degradation, Aquifers.

A case study is used to compare the relative costs of groundwater pollution remediation by carbon adsorption and by air stripping. Costs were calculated for a granular activated carbon adsorption system with thermal regeneration. Results indicate that this process is both capital and operating cost-intensive. The most significant operating cost component is makeup carbon to replace that lost to generation of fine particles or combustion in the regeneration process. Either a carbon adsorption or air stripping unit could be constructed to remove organic compounds from a 3.6 MGD groundwater flow stream from production and/or recovery wells. Air stripping with direct discharge (no air emission controls) is by far the least expensive alternative. The addition of air emission controls drives the cost up an order of magnitude to approximately the level of liquid phase carbon adsorption. The use of biological degradation was also considered. Although biodegradation in situ is hindered by various microbiological, hydrogeological, and chemical factors, the advantages of biological treatment compared to carbon and air stripping are often substantial and dramatic. It can also be cost-effective and nonpolluting. Preliminary results indicate that large-scale biological degradation can result in removal efficiencies of 90% to 96% at costs of $40/cu yd. (Doria-PTT)
W88-10408

CATALYTIC OXIDATION OF GROUNDWATER STRIPPING EMISSIONS,
Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
M. Kosusko, M. E. Mullins, K. Ramanathan, and T. N. Rogers.
Environmental Progress ENVPDI, Vol. 7, No. 2, p 136-142, May 1988. 3 fig, 2 tab, 14 ref.

Descriptors: *Oxidation, *Water treatment, *Chemical treatment, *Groundwater pollution, *Air pollution, *Air stripping, Water pollution, Catalysts, Case studies, Environmental protection, Cost analysis, Organic compounds, Solvents, Organic solvents, Hydrocarbons, Chlorinated hydrocarbons, Fuel, Adsorption, Carbon, Incineration, Performance evaluation.

The applicability of catalytic oxidation to control gaseous effluents resulting from air stripping of groundwater is reviewed, with special attention to system design. Several commercially available catalytic incinerators are described, although few of these have been used in conjunction with an air stripping unit. Case studies are presented, and system economics are discussed. It is concluded that catalytic destruction is an attractive technology because: (1) the contaminants are destroyed, not simply transferred to another phase; (2) destruction efficiencies in excess of 95% are readily attained; (3) it represents a cost-effective alternative to other available technologies; and (4) commercial units are currently available. However, data are limited. Control of air emissions from air stripping units differs from other applications because of the low concentrations of contaminants, the high humidity, and catalyst deactivation. Laboratory-scale research on matching of catalyst to contaminant, selection of reactor type and operating temperatures, and development of techniques for performance evaluation will greatly aid transfer of the technology to the field. (Doria-PTT)
W88-10409

EFFECTIVENESS OF VARIOUS AQUIFER RESTORATION SCHEMES UNDER VARIABLE HYDROGEOLOGIC CONDITIONS,
H and A of New York, Rochester.
R. L. Satkin, and P. B. Bedient.
Groundwater GRWAAR, Vol. 26, No. 4, p 488-499, July-August, 1988. 9 fig, 5 tab, 23 ref.

Descriptors: *Aquifer restoration, *Hydrologic models, *Cleanup operaitons, *Groundwater pollution, *Simulation analysis, *Numerical models, *Well patterns, Injection wells, Pump wells, Geohydrology, Water pollution control, Memthjod of characteristics model, Decontamination.

The USGS method of characteristics model is a useful tool for evaluating different well patterns in an aquifer restoration scheme under variable hydrogeologic conditions. The best well pattern for a ground-water cleanup is highly site-specific and depends upon the objectives and constraints for each problem. In this study, seven different well patterns were investigated to determine the one(s) most efficient in achieving a range of desired levels of contaminant reduction. The well patterns were evaluated on the basis of cleanup time, volume of water circulated, and volume of water requiring treatment. Eight generic hydrogeologic conditions were modeled using different combinations of drawdown, hydraulic gradient, and dispersivity. The key hydrogeologic variables which control the rate of cleanup are well locations, pumping rates, transmissivity, dispersivity, and hydraulic gradient. For a given set of well locations, by varying transmissivity and maintaining drawdown, dispersivity, and hydraulic gradient constant, the cleanup time was found to be inversely related to the pumping rate. (Author's abstract)
W88-10422

NATURAL NITRATE REMOVAL FROM GROUNDWATERS. POSSIBILITY OF APPLICATION TO THE RECLAMATION OF GRAVEL PIT LAKES (EPURATION NATURELLE DES NITRATES DES EAUX SOUTERRAINES: POSSIBILITES D'APPLICATION AU REAMENAGEMENT DES LACS DE GRAVIERES),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
L. Labroue, and G. Pinay.
Annales de Limnologie ANLIB3, Vol. 22, No. 1, p 83-88, 1986. 4 fig, 1 tab, 13 ref.

Descriptors: *Nitrates, *Forest hydrology, *Lakes, *Borrow pits, *Self-purification, *Cleanup operations, *Water quality control, Vegetation, Alder trees, Gravel, Groundwater quality, Organic compounds.

The disappearance of nitrate from shallow groundwaters circulating beneath an alder forest, along with the direct measurement of N2O emission from the soil (acetylene method) show the capacity of this type of vegetation to improve groundwater quality. The activity of the system seems to be more efficient than that observed in surface waters due to the concurrence of favorable factors: a supply of available organic carbon, anaerobic conditions and easy NO3(-) transport. Considering the efficiency of the process, it is suggested that the reclamation of gravel pit lakes upstream of waterworks with alders could improve the water quality. (Author's abstract)
W88-10474

METHODS OF BACKGROUND ENVIRONMENTAL POLLUTION MONITORING APPLIED IN CMEA MEMBER COUNTRIES,
Akademiya Nauk SSSR, Moscow. Natural Environment and Climate Monitoring Lab.

For primary bibliographic entry see Field 5A.
W88-10544

SEDIMENT DISPERSAL IN THE KNYSNA ESTUARY: ENVIRONMENTAL MANAGEMENT CONSIDERATIONS,
Port Elizabeth Univ. (South Africa). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W88-10563

DISTRIBUTION OF MACROINVERTEBRATES IN THE SHALLOW PART OF 'DE GIJSTER', A WATER STORAGE LAKE IN THE BIESBOSCH (THE NETHERLANDS),
Rijksmuseum van Natuurlijke Historie, Leiden (Netherlands).
J. Huisman, and L. W. C. A. Van Breemen.
Hydrobiological Bulletin HYBUD9, Vol. 19, No. 2, p 199-206, December 1986. 3 fig, 4 tab, 23 ref.

Descriptors: *Netherlands, *Water pollution effects, *Water pollution treatment, *Ecological distribution, *Reservoirs, *Macroinvertebrates, *Limnology, *Population dynamics, Species composition, Spatial distribution, Aquatic habitats, Aquatic animals, Lakes, Life cycle studies, Lake De Gijster.

De Gijster is the largest of three reservoirs of a water-storage system in the Biesbosch, the Delta of the Rhine and Meuse Rivers. The system is fed with highly eutrophic water from the Meuse. The composition and distribution of the macroinvertebrate fauna of the shallow part of 'De Gijster' was studied in 1984. The numerous individuals collected belong mainly to the Oligochaeta, Diptera (Chironomidae larvae) and Mollusca. Among them are elements of both the former polder fauna and the river fauna. A quantitative analysis revealed data on the horizontal distribution of several taxa within the lake as well as data on the influence of the lifecycle of some taxa on the annual composition of the fauna. (Author's abstract)
W88-10578

REGIONAL INITIATIVES IN WATER QUALITY MANAGEMENT: THE EXPERIENCE OF THE FORMER NEW ENGLAND RIVER BASINS COMMISSION,
New England Governors' Conference, Inc., Boston, MA.
For primary bibliographic entry see Field 6E.
W88-10633

REMOVAL OF NICKEL FROM POLLUTED WATER USING DECAYING CYPRESS LEAVES,
Al-Najah National Univ., Nablus (Jordan). Dept. of Chemistry.
R. Salim.
Journal of Environmental Science and Health JESEDU, Vol. 23, No. 4, p 331-334, May 1988. 7 fig, 2 tab, 7 ref.

Descriptors: *Cypress trees, *Water pollution treatment, *Water quality control, *Nickel, *Leaves, Chemical properties, Pollutants, Ions, Hydrogen ion concentration, Water treatment.

Cypress leaves have been found capable of removing nickel ions from water. The maximum capacity of this removal process appears to be at a pH of about 8.5. Several of the factors affecting this removal process have been studied. These factors include the concentration of cypress leaves, the concentration of nickel, and the presence of competing ions. The release of nickel from cypress leaves by the effect of changing pH or the addition of competing ions was also studied. Cypress leaves were found capable of changing the pH of water. This capability was also investigated and the effect of concentration of cypress leaves on the rate of variation of pH was investigated. Results of the study showed that the rate of nickel uptake on cypress leaves increases highly with the increase of concentration of leaves up to a limit, after which the increase of the concentration of cypress leave results only in a small increase in nickel uptake. Cypress leaves are capable of an overall reduction of the pH of water. This reduction in pH is high at first and then slows down before it increases slightly to reach a steady value. Both the rate of pH change and the amount of this change are dependent on the concentration of leaves. (Friedmann-PTT)
W88-10639

DISSOLVED ORGANIC CARBON, SESTON AND MACROINVERTEBRATE DRIFT IN AN ACIDIFIED AND LIMED HUMIC STREAM,
Lund Univ. (Sweden). Dept. of Ecology.
A. Kullberg, and R. C. Petersen.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 553-564, June 1987. 5 fig, 5 tab, 34 ref.

Descriptors: *Acid rain, *Water pollution treatment, *Aquatic drift, *Acidic water, *Dissolved organic carbon, *Lime, *Macroinvertebrates, Seston, Streams, Sampling, Water quality, Oligotrophic lakes, Ecology, Chemical analysis, Rivers, Hydrogen ion concentration, Alkalinity, Benthic environment, Fyllean River, Lakes, Sweden, Predators.

Total seston, and invertebrate drift were studied before and after lime addition to the Fyllean River, a stream-lake system in Halland county, southwest Sweden, with poorly buffered waters undergoing acidification. The largest effect of liming was on the chemistry of the water. Water chemistry values are detailed. The lakes in the river system had a larger effect on seston concentration than any effect of the lime addition by itself. Particle concentrations were reduced by 50-55% and dissolved organic carbon (DOC) by about 1 mg C per liter as the water passed through the lakes. Macroinvertebrate drift density was low in all samples before and after liming and typical of oligotrophic streams. Drift was significantly lower at limed (0.024 individuals per cubic meter) than at unlimed (0.083 individuals per cubic meter) locations. The decrease was only in total drift density, with no significant change in the relative abundance of functional groups or in densities of single taxa, except for a reduction in drift of predators in the limed condition. (Author's abstract)
W88-10666

PHOSPHORUS INACTIVATION IN A EUTROPHIC LAKE BY THE DIRECT ADDITION OF FERRIC ALUMINIUM SULFATE: IMPACT ON IRON AND PHOSPHOROUS,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
R. H. Foy.
Freshwater Biology FWBLAB, Vol. 15, No. 5, p 613-629, October 1985. 10 fig, 7 tab, 33 ref.

Descriptors: *Limnology, *Phosphorus removal, *Phosphorus, *Eutrophic lakes, *Ferric aluminum sulfate, *Iron, *Lake restoration, Hypolimnion, Epilimnion, Sediments, Nutrients, Ecology, White Lough, Northern Ireland, Chemical analysis, Water sampling, Isotherms.

Following addition of ferric aluminum sulfate (FAS) in February 1980 to a eutrophic lake, White Lough, Northern Ireland, the cycles of phosphorus (P) and iron (Fe) over 34 months were compared to those in the 18 months preceding the application. During the summer of 1980, P release to the hypolimnion was reduced by 92% compared to 1979 but by 1982 had returned to pre-treatment levels. Phosphorus budget calculations for the post-treatment period indicated that P was accumulating in the sediment at a rate sufficient to permit the recovery of P release. In the 3 summers following FAS addition, Fe released into the hypolimnion increased by 56-71% compared to 1979 but this increase represented less than 10% of Fe added in teh FAS. Prior to FAS treatment, hypolimnetic Fe and P were mixed throughout the lake at overturn, resulting in high winter concentrations, but after treatment, overturn was accompanied by large reduction in the lake Fe and P content due to precipitation. As a result, overwintering P concentrations in 1980 to 1981 and 1981 to 1982 were in the range 31-53 microg P per l compared to 111-194 microg P per l in 1978 to 1979 and 1979 to 1980. The reduction of hypolimnetic P release in 1980 and 1981 and lower overwintering P had little impact on summer epilimnetic P concentrations which for 1979 to 1982 were 51, 36, 47 and 48 microg P per l respectively. Phosphorus concentrations in the epilimnion were raised between April and June in each year by a release of P into the epilimnion. August and September was the only period when reductions in hypolimnetic P were reflected in lower P concentrations in the epilimnion. (Author's abstract)
W88-10689

ROLE OF FISH IN THE REGULATION OF NUTRIENT CYCLING IN LAKE BALATON, HUNGARY,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 2H.
W88-10703

PRODUCTION OF THE CHIRONOMID PROCLADIUS BELLUS IN AN ANNUAL DRAWDOWN RESERVOIR,
Department of Fisheries and Oceans, Charlottetown (Prince Edward Island). Fisheries Research Branch.
For primary bibliographic entry see Field 2H.
W88-10717

PROBLEMS AND POTENTIAL FOR IN SITU TREATMENT OF ENVIRONMENTAL POLLUTANTS BY ENGINEERED MICROORGANISMS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
R. K. Jain, and G. S. Sayler.
Microbiological Sciences, Vol. 4, No. 2, p 59-63, February 1987. 1 fig, 3 tab, 22 ref.

Descriptors: *Genetic engineering, *Fate of pollutants, *Water pollution treatment, *In situ wastewater treatment, *Microorganisms, *Microbiological studies, *Microbial degradation, *Biodegradation, Deoxyribonucleic acid, Wastewater treatment, Risk.

Molecular microbial ecology could provide tools for studying the structure and function of biodegradative microbial communities useful for in situ removal of environmental pollutants. Detection and monitoring of released organisms in the environment is required and DNA:DNA colony hybridization seems to be one of the highly sensitive and accurate technologies available for achieving this goal. A realistic and pragmatic view is required for analysis of the risks of environmental release of genetically-modified or of engineered organisms. (Author's abstract)
W88-10743

MANAGEMENT OF ARTIFICIAL REEFS DESIGNED TO SUPPORT NATURAL COMMUNITIES,
Lockheed-Georgia Co., Marietta.
J. W. Carter, W. N. Jesse, M. S. Foster, and A. L. Carpenter.
Bulletin of Marine Science BMRSAW, Vol. 37, No. 1, p 114-128, July 1985. 1 fig, 7 tab, 33 ref.

Descriptors: *Wildlife management, *Ecosystems, *Succession, *Artificial reefs, *Kelp, *Aquatic habitats, *Aquatic plants, Predation, Coastal waters, Electric powerplants, Food habits, Food chains, Environmental effects, Ecological effects, Design standards, Reefs.

Pendleton Artificial Reef (PAR) was designed to determine the potential of artificial reefs for mitigating possible losses of kelp-reef habitat caused by operation of coastal power plants. In an attempt to alter natural succession on PAR, massive transplants (hundreds of individuals) of two kelp species and juvenile abalone have been conducted. Although the PAR site once supported a kelp forest, kelp transplant efforts were not successful, principally because of intensive grazing by two herbivorous fish; halfmoon and opaleye. Similarly, abalone

transplantation was not successful, probably because of crab predation and lack of suitable food. In hindsight, these attempts at manipulating succession may have been successful if the densities of grazing fish were artificially reduced, if abalone additions were delayed until more algae were present, and if abalone transplant techniques were used that would minimize predation. Management of artificial reefs should not be limited to only initial planning, but should also consider manipulating succession after placement. Initial planning should consider the physical and chemical environment (past and present), the biological environment, the design, size, and configuration of the artificial habitat relative to local natural habitats, as well as other factors that affect the quality of the subhabitats. After an artificial reef has been constructed, there are additional factors that will influence community development. These include timing of reef installation and possible post-reef-placement management techniques. Our general conclusions with respect to succession on PAR is that although initial reef planning factors are important, these are subordinate to reef management techniques after installation. (Author's abstract)
W88-10748

MODELING OF HIERARCHICAL STRUCTURES IN WATER QUALITY CONTROL,
Ceskoslovenska Akademie Ved, Prague. Ustav Teorie Informace a Automatizace.
L. Bakule.
Limnologica LMNOA8, Vol. 17, No. 2, p 233-236 , October 1986.

Descriptors: *Model studies, *Water quality control, *Water quality management, *Feasibility studies, Wastewater treatment, Management planning.

Modeling and control of complex systems include, in most cases, the hierarchical structure. The mathematical modeling of hierarchically structured control with the emphasis on modeling of water quality control The structure of hierarchical optimization and system decomposition was surveyed. Basic coordination methods are summarized. An example of a hierarchical water quality problem is considered, while the decomposition of systems is generally characterized. Feasible and non-feasible methods for static multilevel multiobjective problems are reviewed. The known single-level wastewater treatment plant model is extended into the multilevel multiobjective framework formulation. (Friedmann-PTT)
W88-10808

ECOTECHNOLOGICAL MEASURES AGAINST EUTROPHICATION,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
M. Straskraba.
Limnologica LMNOA8, Vol. 17, No. 2, p 237-249, October 1986. 2 fig, 2 tab, 43 ref.

Descriptors: *Eutrophication, *Water quality management, *Water pollution control, *Nutrients, Organic matter, Productivity, Technology, Biological properties, Feasibility studies.

Ecotechnology is understood to cover technological means for ecological management with respect to ecosystem problems as a whole. The position of eutrophication among water pollution problems is characterized as a two-stage process (nutrients – organic matter production), spreading of nutrients dominantly through water from both point and diffuse sources and fairly high assimilative capacity of the environment for the organic matter produced. Preventive ecotechnological measures based on these characteristics are reviewed and/or developed, including: use of pre-impoundments, the Wahnbach system, phosphorus inactivation, decreasing light transmissivity, throughflow regulation, biomanipulation and some other measures. A new procedure, artificial epilimnetic mixing, is suggested. Such measures are not only technologically feasible, but mostly cheaper than the classical ones. (Author's abstract)
W88-10809

IMPROVEMENT OF THE MITRE MODEL FOR PRIORITIZATION OF HAZARDOUS WASTE SITE REMEDIATION,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
D. B. Aulenbach, and A. G. Woodard.
Northeastern Environmental Science NOESDE, Vol. 6, No. 2, p 82-88, 1987. 2 fig, 1 tab, 4 ref.

Descriptors: *Water pollution control, *Hazardous wastes, *Priorities, *MITRE Model, *Model studies, *Cleanup operations, Environmental policy, Waste storage, Decision making, Planning, Evaluation, Remedies, Performance evaluation, Comparison studies, Superfund sites.

There are some disagreement among users over the value of the MITRE Model which the EPA has promulgated for ranking hazardous waste sites. The model is designed to compare sites using a number system, with sites reaching a given number being eligible for site remediation funding under CERCLA (Superfund). In many instances, technical information on a site may be missing or inadequate. This makes assessing a number system difficult. A method is proposed to provide expert judgment ot substitute for missing technical information. A multiattribute decision analysis methodology is proposed to include: (a) the use of a classification protocol; (b) round robin group discussions; (c) critical evaluations of technical information and MITRE Model scores; and (d) assessment of value judgments elicited from experts and managers. In order to identify important evaluating criteria for ranking sites, a comparison was made of value judgments, important weights, and criteria descriptions provided by experts and managers. Existing sites were then classified according to these evaluating criteria and compared with the results obtained using the MITRE Model. Studies that were conducted supported the use of the multiattribute methodology for comparing severity of problems among sites and assessing a ranking. Order of magnitude estimates among the sites supported the more comprehensive nature of this methodology, thus providing improved accuracy and precision in ranking individual sites as compared with the MITRE scores. A method for incorporation of this methodology into the MITRE model is suggested. (Author's abstract)
W88-10870

OPPORTUNITY FOR INTEGRATED MANAGEMENT OF THE FLATHEAD RIVER-LAKE ECOSYSTEM, MONTANA,
Northwest Power Planning Council, Portland, OR.
D. Cross.
Fisheries, Vol. 12, No. 2, p 17-22, March-April 1987. 1 fig, 1 tab, 11 ref.

Descriptors: *Public policy, *Resources management, *Water quality management, *Wildlife management, Ecosystems, Dams, Hydroelectric plants, Legislation, Fish management, Flathead River, Flathead Lake, Montana, Government interrelations.

In Montana's Flathead River basin, studies resulting from the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, and the relicensing of Kerr Dam, sited on lands of the Confederated Salish and Kootenai Tribes, demonstrate the need for a holistic sub-basin approach to aquatic resource management at the ecosystem level. Strong direction and leadership from the Flathead Basin Commission to develop an integrated aquatic resource management plan, which will facilitate coordinated local management of the aquatic ecosystem, can avoid exploitation by out-of-basin interests taking advantage of local divisiveness. (Author's abstract)
W88-10898

SENSITIVITY ANALYSIS OF OPTIMAL GROUND WATER CONTAMINANT CAPTURE CURVES: SPATIAL VARIABILITY AND ROBUST SOLUTIONS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W88-10920

DEVELOPMENT OF QUANTITY AND QUALITY MODEL FOR OPTIMAL GROUNDWATER MANAGEMENT,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W88-10922

SOURCE TERM EQUATIONS AND SOLUTE TRANSPORT MODEL FOR CONSUMPTIVE USE PERMIT APPLICATION,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5B.
W88-10925

PREDICTION OF THE FATE OF CHROMIUM FROM A PROPOSED MUNICIPAL SANITARY LANDFILL,
Foth and Van Dyke and Associates, Inc., Green Bay, WI.
For primary bibliographic entry see Field 5B.
W88-10926

REMEDIAL INVESTIGATION AND DESIGN FOR A MINE-TAILINGS WASTEWATER FACILITY IN SOUTHWESTERN WYOMING,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5B.
W88-10927

ELIMINATING CONTAMINANT STAGNATION AREAS: A KEY TO OPTIMIZING GROUND WATER RECOVERY SYSTEM DESIGNS,
AWARE, Inc., West Milford, NJ.
W. G. Soukup, and M. S. Quinn.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 313-323, 6 fig, 2 ref.

Descriptors: *Cleanup operations, *Water pollution treatment, *Groundwater pollution, *Path of pollutants, *Organic compounds, *Model studies, Solvents, Plumes, Trichloroethylene, Stagnant water, Des Moines, Iowa, Mathematical models, Cost analysis, Optimization, Design criteria, Construction costs.

Stagnant areas of contaminated water in a groundwater system were identified and evaluated during a study of a plume of trichloroethylene threatening the potable water supply of Des Moines, Iowa. A refined two-dimensional groundwater flow model was developed to optimize a conceptual design for cleanup of the contamination. The model was then used to evaluate a variety of modifications to the proposed conceptual well locations and pumping rates. The model showed that a significant reduction in cleanup time would be realized by eliminating the groundwater divide and thus the contaminant stagnation area developed beneath the divide. The optimized system eliminated the need for three wells, reduced total pumpage by 1.7 billion gallons and reduced system design, construction and operational costs by over $350,000. (See also W88-10912) (Cassar-PTT)
W88-10928

APPLICATION OF A GROUND WATER MODEL FOR MANAGEMENT OF SEA WATER INTRUSION IN SALINAS VALLEY, CALIFORNIA,
Boyle Engineering Corp., Lakewood, CO.
For primary bibliographic entry see Field 5B.
W88-10937

THREE-DIMENSIONAL MODELING ANALYSIS OF GROUND WATER PUMPING SCHEMES FOR CONTAINMENT OF SHALLOW GROUND WATER CONTAMINATION,
Papadopulos (S.S.) and Associates, Inc., Rockville, MD.
S. P. Larson, C. B. Andrews, M. D. Howland, and D. T. Feinstein.

IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 517-531, 8 fig, 7 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Water quality control, *Groundwater movement, *Model studies, Water table, Spatial distribution, Hydraulic containment, Mathematical models, Pumping, Recharge, Monitoring.

Three-dimensional analysis of groundwater path lines provided significant insight into the nature of flow patterns associated with pumping schemes to removal and/or control contamination from the shallow groundwater environment. It was found that (1) the rate of recharge determines the area of containment or capture of a pumping well and (2) permeability conditions affect the shape of the capture zone for a pumping well but do not affect the area of containment. These results indicate that hydraulic containment of groundwater contamination can be achieved at relatively low rates of pumping even if the groundwater environment is highly permeable. However, the subtle water level fluctuations associated with low pumping rates may be difficult to distinguish from noise in the data. (See also W88-10912) (Cassar-PTT)
W88-10938

REMEDIAL ACTIONS UNDER VARIABILITY OF HYDRAULIC CONDUCTIVITY,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
A. I. El-Kadi.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 705-726, 11 fig, 3 tab, 30 ref.

Descriptors: *Recovery wells, *Path of pollutants, *Groundwater pollution, *Water quality control, *Stochastic process, *Model studies, Mathematical models, Wells, Plumes, Aquifers, Hydraulic conductivity, Mass transport.

The stochastic approach was applied to evaluate selected remedial actions involving recovery wells. This was done to answer the problem of frequent failure of the classic dispersion equation to describe mass transport. A Monte-Carlo technique was adopted in the analysis of the two cases: an injection/recovery well and plume capture by a production well. Variability caused a dispersion-like phenomenon which affected the shape of plume and breakthrough curves. Defining effective dispersivities representing the average stochastic results for use in deterministic analysis failed to recognize the important variability features described by stochastic analysis. In addition, stochastic analysis allowed the quantification of uncertainty regarding output results. (See also W88-10912) (Cassar-PTT)
W88-10947

COMPUTER AIDED SITE INVESTIGATION AND MANAGEMENT: A TOOL FOR ASSESSING AND MANAGING GROUNDWATER CONTAMINATION,
Hydro Geo Chem, Inc., Tucson, AZ.
G. R. Walter, H. W. Bentley, V. K. Gupta, and J. Carrera.
IN: Proceedings of the NWWA Conference on Solving Ground Water Problems with Models. National Water Well Association, Dublin, OH. 1987. p 782-790, 2 fig, 3 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Water quality control, *Model studies, *Computers, Mathematical models, Computer models.

Computer models should be used throughout the investigation and management of contaminated hydrogeologic sites, rather than only in the final stages. Models can be incorporated into the site characterization effort as early as the initial proposal. They can be useful in identifying what data should be collected. As data are collected, they are used to update and refine the models and their predictions. Project cost are minimized because data collection can often be limited to relevant areas. (See also W88-10912) (Cassar-PTT)
W88-10951

COMBINED MODELING PROGRAM FOR EVALUATING THE COVER DESIGN AT A URANIUM MILL TAILINGS DISPOSAL SITE,
Colorado Geological Survey, Denver.
For primary bibliographic entry see Field 5E.
W88-10954

MODELING OF GROUND WATER FLOW THROUGH A WP-CAVE,
Uppsala Geosystem A.B. (Sweden).
For primary bibliographic entry see Field 5E.
W88-10955

APPLICATION OF STOCHASTIC GROUND WATER MODELS TO GEOLOGIC DISPOSAL OF HIGH-LEVEL NUCLEAR WASTE,
Rockwell International, Richland, WA. Rockwell Hanford Operations.
For primary bibliographic entry see Field 5E.
W88-10957

GRID REFINEMENT APPROACH TO FLOW AND TRANSPORT MODELING OF A PROPOSED GROUND-WATER CORRECTIVE ACTION AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-10967

AUTOMATED GIS FOR GROUND WATER CONTAMINATION INVESTIGATION,
Environmental Systems Research Inst., Redlands, CA.
For primary bibliographic entry see Field 5B.
W88-10969

USE OF THE VERTICAL HORIZONTAL SPREAD (VHS) MODEL FOR DELISTING HAZARDOUS WASTE,
Minnesota Mining and Mfg. Co., St. Paul.
For primary bibliographic entry see Field 5B.
W88-10981

GROUND WATER FLOW MODELING AT A HAZARDOUS WASTE SITE FOR REGULATOR COMPLIANCE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-10984

AQUATIC TOXICOLOGY AND HAZARD ASSESSMENT: EIGHTH SYMPOSIUM.
For primary bibliographic entry see Field 5C.
W88-10991

SCIENTIFIC CONSIDERATIONS IN THE INTERNATIONAL ARENA,
Unilever Research Port Sunlight Lab. (England).
For primary bibliographic entry see Field 6E.
W88-10993

CLEAN WATER ACT UPDATE: A NEW ROLE FOR TOXICOLOGY,
Environmental Protection Agency, Washington, DC. Office of Analysis and Evaluation.
P. L. Wise.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 29-34, 3 ref.

Descriptors: *Clean Water Act, *Aquatic toxicology, *Legislation, *Water quality control, *Toxicology, Information exchange, Biological studies, Economic aspects, Water pollution control, Model studies, Costs.

Implementation of the Clear Water Act started with development of water pollution controls using the tools of engineering and mathematical modeling. As implementation of the act has evolved, however the importance of toxic pollutants and the need for new and different toxicological methods, to analyze toxic pollution and set cost-effective toxic effluent controls has been recognized. To deal with this new challenge, an approach for regulating toxic effluents is being put together. There has been little experience in using toxicological methods and tests for regulating effluents, yet a new regulatory approach is needed. The help of the scientific community of toxicologists, is needed now to develop toxicological tools that can be used in the cost-effective analysis and control of toxic water pollution. (See also W88-10991) (Author's abstract)
W88-10994

WHAT INDUSTRY IS DOING TO PROTECT AQUATIC LIFE,
Dow Chemical Co., Midland, MI.
H. C. Alexander, and J. A. Quick.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 37-44, 1 fig, 13 ref.

Descriptors: *Aquatic environment, *Aquatic life, *Toxicology, *Water quality control, *Chemical industry, Aquatic toxicology, Environmental effects, Recycling, Wastewater treatment, Landfills, Biomonitoring, Hazard assessment, Water pollution prevention, Incineration.

Much of the chemical industry has had long-term environmental involvement and commitment. The hazard evaluation process is being used by industry to evaluate its products, by-products, and waste for potential environmental effects. Fate and effects testing are the core of this process and provide the data for estimating hazards. The adverse environmental impact of wastes is minimized by recycling or reuse, chemical or biological treatment, high-temperature incineration, and secure landfilling. Biomonitoring and field surveys assess the environmental impact of effluents and product applications. Industry is concerned about the proper use, safe handling, and environmental impact from product use and disposal. (See also W88-10991) (Author's abstract)
W88-10995

WATER QUALITY CRITERIA: PROTECTION OF USE PERSPECTIVE,
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
F. E. Gostomski.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 45-47, 7 fig.

Descriptors: *Water quality control, *Standards, *Regulations, *Water pollution control, *Toxicology, *Recreation, *Aquatic toxicology, *Water quality standards, State jurisdiction, Fishing, Swimming, Public participation, Clean Water Act.

A water quality standard is a rule or law comprised of the use or uses to be made of a water body or segment and the water quality criteria necessary to protect that use or uses. States have primary responsibility for establishing appropriate uses of water bodies through a periodic review process involving consultation with the EPA and public hearings, which must occur at least once every three years. Where designated uses do not include those specified in the goals of the Clean Water Act (that is, fishable/swimmable), the state is required to conduct a use attainability analysis. The EPA has provided guidance for doing such an

analysis. Criteria are elements of state water quality standards expressed as constituent concentrations or levels, or narrative statements, that represent a quality of water that supports a particular use. When criteria are properly selected and met, it is presumed that water quality will protect the designated use. The EPA is recommending that states develop site-specific criteria to reflect local conditions and has provided guidance for doing so. (See also W88-10991) (Author's abstract)
W88-10996

RESEARCH NEEDS FOR RAPID ASSESSMENTS OF CHRONIC TOXICITY,
Kentucky Univ., Lexington. Graduate Center for Toxicology.
W. J. Birge, and J. A. Black.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 51-60, 29 ref.

Descriptors: *Research priorities, *Aquatic toxicology, *Hazard assessment, *Toxicology, *Toxicity, *Bioassay, *Sublethal effects, *Water pollution effects, Biological studies, Toxicology, Water quality control, Minnows, Model studies, Larvae, Fish physiology.

Chronicity frequently is the most important and sensitive factor in determining the impact of toxicant stress on aquatic biota. However, chronic values are often unavailable or inadequate to provide decisive judgments in hazard assessment. Time and cost constraints involved in generating traditional chronic data also pose equally important problems in basic toxicological research. In assessing rapid means for estimating chronicity, attention is given to predictive models based on structure-activity relationships, extrapolations from acute toxicity data, and use of short chronic (mini-chronic) tests. High priority is placed on further development and evaluation of mini-chronic tests, which have been used successfully to characterize single compounds and complex effluents, evaluate effluent treatability, and determine the effects of point-source discharges on natural receiving waters. Methods most commonly used have involved: (1) a five to eight-day fish embryo-larval test; (2) a seven-day cladoceran test; and (3) a seven-day fathead minnow larval growth test. General research needs are summarized as follows: (1) Evaluation of short toxicity tests presently available; (2) Design of multiple species tests, in-stream flow-through tests, and other short-term test procedures for estimating chronic effects of complex effluents and single compounds; (3) Determination of the effects of laboratory and field conditions, general water quality characteristics, and selection of animal species on results of mini-chronic tests; (4) Consideration of nonorganismal tests or mathematical models that may be used to estimate chronicity. Such research may include enzyme inhibition tests, quantitative structure-activity (QSAR)-based modeling, and extrapolations based on acute toxicity data; (5) Investigations of the physiological and biochemical mechanisms involved in acute and chronic toxicity. (See also W88-10991) (Author's abstract)
W88-10997

NEW APPROACH FOR REGULATING IRON IN WATER QUALITY STANDARDS,
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
P. H. Loeffelman, J. H. Van Hassel, T. E. Arnold, and J. C. Hendricks.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 137-152, 1 fig, 34 ref.

Descriptors: *Water quality control, *Regulations, *Water quality standards, *Iron, Aquatic toxicology, Toxicity, Fish, Bathophenathroline, Water pollution effects, Aquatic environment.

An extensive literature review, toxicity tests, and five months of field measurements of ferrous and total iron were undertaken. Published field data and analytical procedures are scarce for ferrous iron; few useful toxicity data are available for any of the forms of iron. Studies demonstrated that total iron concentrations now limited to 1 mg/L in many U.S. water quality standards need to be far over 1 mg/L to adversely affect Pimephales promelus and Salmo gairdneri compared to the much lower concentrations of bathophenathroline reactive ferrous iron required for similar effects on these two species. For most freshwater bodies, regulating only this ferrous iron form should be considered for protecting aquatic life uses. (See also W88-10991) (Author's abstract)
W88-11003

COMPARISON OF QSAR PREDICTIONS WITH FISH TOXICITY SCREENING DATA FO 110 PHENOLS,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5C.
W88-11004

TIME/TOXICITY RELATIONSHIPS IN SHORT-TERM STATIC, DYNAMIC, AND PLUG-FLOW BIOASSAYS,
SRI International, Menlo Park, CA. Aquatic Toxicology Program.
For primary bibliographic entry see Field 7C.
W88-11006

GROUND WATER PROTECTION PLANNING USING THE ERDAS GEOGRAPHIC INFORMATION SYSTEM: AUTOMATION OF DRASTIC AND TIME-RELATED CAPTURE ZONES,
Kansas State Geological Survey, Lawrence.
D. O. Whittemore, J. W. Merchant, J. Whistler, C. E. McElwee, and J. J. Woods.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 359-374, 4 fig, 1 tab, 11 ref.

Descriptors: *Geographic information systems, *Information exchanges, *Data storage and retrieval, *Groundwater management, *Geography, *Information systems, Automation, Planning, Kansas, Municipal water, Irrigation, Water quality control, Geohydrology, Pump wells, Aquifer characteristics, Sensitivity analysis, Maps, Computer programs.

A geographic information system (GIS) is being applied to Harvey County, Kansas, to improve planning efforts by state and local governments in water-resources protection. The GIS package is a user-friendly, flexible, standalone system named ERDAS (Earth Resources Data Analysis System) operating on an IBM PC-AT microcomputer. The study area includes part of a major unconsolidated aquifer used for both municipal supply and irrigation. Kansas has developed a groundwater-quality-protection strategy that recommends the development and implementation of aquifer and/or well-field-protection plans by all public water systems using groundwater. Methodologies applicable to the planning process have been automated for use on the GIS. One of these is the standardized system called DRASTIC developed by the National Water Well Association. Digital GIS data for the seven hydrogeologic factors used in DRASTIC can be computer-processed to produce a map of index values ranking relative vulnerability with respect to groundwater-pollution potential and the boundaries of hydrogeologic settings. Another methodology automated is the generation of time-related capture zones for pumping wells in a well field. An interactive computer program in conjunction with the GIS computes individual capture-area curves given the coordinates and average pumping rate of the well, the average values for the aquifer parameters, and the capture-zone time. The capture-curve equation is solved analytically using the method of successive approximations and three different arrangements of the equation depending on regions of convergence. Results for these methodologies can be easily recomputed for revised or additional data or to determine the sensitivity of the resultant map areas to estimated error in the hydrogeologic data. The GIS also allows convenient overlaying of the DRASTIC index and setting areas and capture-zone boundaries on maps of anthropogenic features such as land use. (See also W88-11031) (Author's abstract)
W88-11053

UNIFIED GROUND WATER MONITORING PROGRAM,
Waste Management of North America, Southfield, MI. Northwest Regional Office.
For primary bibliographic entry see Field 7A.
W88-11054

EVALUATION OF GROUND WATER SUPPLY SYSTEM REHABILITATION,
Black and Veatch, Kansas City, MO.
J. Tavanger.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 457-470, 4 fig, 2 tab.

Descriptors: *Water supply, *Cost-benefit analysis, *Groundwater, *Rehabilitation, *Decision making, Municipal water, Water quality, Water table decline, Operating costs, Economic evaluation, Computer models, Data acquisition.

Because of overpumping in many municipalities, water levels are declining in most aquifers. This has resulted in higher pumping costs and, in some cases, extraction of lower-quality water. Also as water-well systems age and deteriorate, their efficiencies often decline, resulting in lower production rates and higher energy costs. In the case of a decline in well or pump efficiency, a choice must be made regarding the type of rehabilitation measures that would yield the best economic results. A detailed economic-evaluation procedure is presented for selecting the most cost-effective rehabilitation measures from the many alternatives available for improving inefficient systems. An interactive computer model has been developed to facilitate the application of this economic analysis procedure, and to assist in the collection and updating of a database necessary for such an analysis. (See also W88-11031) (Author's abstract)
W88-11058

INITIAL RESPONSE TO A GROUND WATER CONTAMINATION PROBLEM, HANCOCK COUNTY, INDIANA,
Indiana Dept. of Environmental Management, Indianapolis.
D. F. Stropes, and M. W. Sorg.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 471-483, 4 fig, 2 tab, 9 ref.

Descriptors: *Water pollution treatment, *Remedies, *Path of pollutants, *Groundwater pollution, Indiana, Organic compounds, Well water, Interagency cooperation, Public health, Public relations, Water pollution sources, Landfills, Water sampling, Water quality, Public policy.

The Indiana Department of Environmental Management (IDEM) Office of Environmental Response staff identified and responded to volatile-organic-compound groundwater contamination in a private resident's water well in Hancock County in January 1986. Initially, the extent of contamination and possible contaminant sources were unknown. IDEM requested the assistance of the U.S. EPA, Region V. The EPA responded by providing an alternate water supply and rapid laboratory analysis of groundwater samples. Public-health concerns expressed by potentially-affected nearby residents and intense media coverage created a climate such that the IDEM and the EPA had to respond quickly and rationally with an adequate remedial action under less-than-favorable budget

and public-relations conditions. The probable contaminant source was identified as an inactive landfill sited in Wisconsinan-Age sands and gravels. An intensive water-well sampling effort of 67 nearby private residents' water wells, public water-supply wells and a public-school water well was implemented to define the extent of contamination. Once the extent of contamination was determined, the EPA contracted to drill a new well to replace the originally-identified contaminated residential well. To monitor any long-term groundwater quality changes, a predetermined number of wells from the 54 wells of potential impact from the site are selected at random and sampled quarterly until 1992. This remedial action appears to be adequate to date, and the authors suggest a similar approach be implemented for future water-well contamination problems which require immediate action. Future remedial-action investigations for the site and adjacent areas are also presented. (See also W88-11031) (Author's abstract)
W88-11059

ENHANCED NATURAL DEGRADATION OF A SHALLOW HYDROCARBON CONTAMINATED AQUIFER,
Groundwater Technology, Inc., Farmington Hills, MI.
E. A. Radecki, C. Matson, and M. R. Brenoel.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 485-496, 3 fig, 9 ref.

Descriptors: *Fate of pollutants, *Water quality control, *Path of pollutants, *Microbial degradation, *Hydrocarbons, *Groundwater pollution, Aquifers, Michigan, Unconfined aquifers, Sands, Gasoline, Plumes, Leaching, Decontamination, Rehabilitation, Infiltration, Aeration, Bacteria, Soil bacteria, Aerobic treatment, Biotransformation, Groundwater, Bioreclamation.

Enhanced Natural Degradation is one of the newest technologies available for aquifer restoration from hydrocarbon contamination. In northern Michigan a bioreclamation project is presently under way. The site is characterized by a shallow, unconfined aquifer consisting of sands and sandy loams. The contaminant is the dissolved fraction from a gasoline loss to groundwater in 1984. A considerable dissolved hydrocarbon plume resulted that covers over one-and-one-half acres. The dissolved levels remained high due to natural leaching of hydrocarbon compounds into the fluctuating water table from the adsorbed fraction of the loss. By mid-1985 plans were made to commence a full-scale hydrocarbon-remediation program using bioreclamation. An existing population of aerobic, hydrocarbon-utilizing bacteria was stimulated by pre-aerating the infiltration water, and by direct well sparging. The main phase of the program began four weeks after the initial aeration with the addition of chemical nutrients into the groundwater. The bacterial macrocosm has shown a one-hundred-fold increase in population, on the average, across the site. The physiological degradation of hydrocarbons by the resultant biomass has resulted in a reduction (from dissolved and adsorbed phases) in excess of one hundred gallons of gasoline in twelve weeks of operation. Historical data show that conventional pump-and-treat methods (i.e., carbon adsorption) would have taken years to achieve what bioreclamation did in twelve weeks. The gasoline has been transformed into carbon dioxide, water, and harmless soil bacteria. (See also W88-11031) (Author's abstract)
W88-11060

USE OF MICROBIAL IN SITU TREATMENT FOR DETOXIFICATION OF A CONTAMINATED GROUND WATER,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
R. W. Peters, W. L. Oresik, and B. Minsley.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 497-522, 3 fig, 3 tab, 34 ref.

Descriptors: *Water pollution treatment, *Water quality control, *Groundwater, *Path of pollutants, *Microbial degradation, *Detoxification, *Groundwater pollution, Water supply, Drinking water, Decontamination, Public health, Aquifer systems, Michigan, Organic compounds, Chlorinated hydrocarbons, Feasibility studies.

Removal of the contaminants from the contaminated groundwater system is of utmost importance to the public health. In a particular aquifer system in Kalamazoo, Michigan, the groundwater system has been contaminated by tetrachloroethylene, trichloroethylene, brominated solvents, cis-1,2-dichloroethylene, and vinyl chloride. Through cooperative agreements established between Purdue University and the City of Kalamazoo, the use of an emerging technology, microbial in-situ treatment, is being investigated for detoxification of a contaminated groundwater supply. Progress to date on this research is described. Feasibility of the in situ treatment method soil columns packed with soil taken from the saturated aquifer. The soil columns are operated as a continuous upflow system analogous to that of a continuous flow fixed bed reactor. (See also W88-11031) (Shidler-PTT)
W88-11061

ARMY INSTALLATION RESTORATION PROGRAM: CONTAMINATED SOIL CLEANUP OBJECTIVES FOR AN INACTIVE ARMY AMMUNITION PLANT,
Army Biomedical Research and Development Lab., Fort Detrick, MD.
D. H. Rosenblatt, and R. B. Turkeltaub.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 523-527.

Descriptors: *Water quality control, *Groundwater, *Path of pollutants, *Soil contamination, *Decontamination, Nebraska, Public policy, Public relations, Water pollution sources, Leaching, Cesspools, Industrial wastewater, Incineration, Water quality standards, Groundwater movement, Test wells, Plumes, Munitions.

The Army is committed to removing the sources of groundwater pollution resulting from its past industrial activities. In 1985, having become aware of the presence of munitions compounds in a groundwater plume moving from the inactive Cornhusker Army Ammunition Plant toward the suburbs of Grand Island, Nebraska, the Army informed the public of the situation. Plans were instituted to provide the affected population with safe water and to remove the contaminated sources (leaching pits and 'cesspools' where munitions-containing wastewaters had been discarded) by incineration. Removal criteria were based on the direct relationship of permissible residual soil concentrations to drinking-water criteria, soil/water partition coefficients, annual flow rate of the contamination plume, screened length of sampling wells, and the plume width (about one mile)--and on the inverse relationship to annual recharge and the total area contaminated by a particular compound. The cleanup criteria recommended for three of the compounds were within state-of-the-art analytical capabilities, namely 5 ppm for TNT (2,4,6-trinitrotoluene), 10 ppm for RDX (cyclotrimethylenetrinitramine), and 15 ppm for TNB (1,3,5-trinitrobenzene). Since 2,4-DNT (dinitrotoluene) and 2,6-DNT were present in low concentrations associated with much higher TNT concentrations, it is assumed that adequate cleanup of TNT will assure sufficient removal of the DNTs. The criteria have been accepted by the State of Nebraska and cleanup operations will soon begin. (See also W88-11031) (Author's abstract)
W88-11062

CLASS I INJECTION WELL MONITORING: ISSUES AND ANSWERS,
Golden Strata Services, Inc., Houston, TX.
T. A. Jones, and J. S. Haimson.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 531-541, 7 ref.

Descriptors: *Monitoring, *Underground waste disposal, *Groundwater, *Injection wells, *Observation wells, *Public policy, *Well regulations, Water law, Hazardous materials, Deep wells, Groundwater movement, Aquifers, Path of pollutants, Water pollution prevention, Drinking water, Water quality control, Guidelines.

The 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act have brought considerable attention to the practice of underground injection. Current Environmental Protection Agency regulations require all owner/operators of Class I hazardous injection wells to address the issue of groundwater monitoring. This issue centers on the feasibility of installing deep monitoring wells to determine the potential for fluid movement above the confinement system. There has been much debate over the ability and practicality of monitoring aquifers thousands of feet below the ground surface. In fact, the majority of permitted hazardous injection wells are not externally-monitored in this manner. As such, an examination of the technical issues considered most pertinent for the monitoring of Class I wells is presented. These issues and answers review the potential pathways for upward fluid movement and relevant mechanisms for monitoring-well integrity. In particular, the issues of siting, number, and depth are the most critical in evaluating the effectiveness of deep monitoring wells. Although monitoring wells are useful in selected monitoring applications, it is apparent they are not a panacea. Only in certain situations do they offer improved protection of underground sources of drinking water. (See also W88-11031) (Author's abstract)
W88-11063

OVERVIEW OF NITROGEN MANAGEMENT FOR CONSERVATION TILLAGE SYSTEMS: AN OVERVIEW,
Minnesota Univ. Technical Coll., Waseca.
For primary bibliographic entry see Field 4D.
W88-11070

ASSESSMENT OF GREAT LAKES TILLAGE PRACTICES AND THEIR POTENTIAL IMPACT ON WATER QUALITY,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 4C.
W88-11083

INVESTIGATION OF LEAKING UNDERGROUND STORAGE TANKS AND GROUND WATER RESTORATION IN SOUTHEASTERN FLORIDA,
CH2M Hill, Deerfield Beach, FL.
T. S. Sharp, A. Muniz, and S. Skehan.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 1-17, 4 fig.

Descriptors: *Water pollution sources, *Water quality control, *Florida, *Groundwater pollution, *Legislation, *Underground storage, Storage tanks, Petroleum products, Leakage, Potable water, Biscayne aquifer, Cleanup, Oil pollution.

Southeastern Florida's primary source of potable water is the Biscayne aquifer, an extremely prolific aquifer of high permeability. Its nearness to ground surface makes it susceptible to contamination from point and non-point sources, including leaking underground storage tanks. Recent regulations enacted by Dade and Broward Counties have established criteria with the goal of cleaning up and protecting potable water resources from further contamination. A specific sequence of activities is called for in the criteria: (1) Anyone maintaining an underground storage tank containing a potentially hazardous substance such as gasoline or oil must investigate for subsurface leaks or discharges, generally through a preliminary groundwater investigation (PGWI). (2) Any discharge must be reported to the appropriate agency, which will issue a notice of violation and require preparation of a contamination assessment plan (CAP). The CAP outlines procedures needed to determine the extent of contamination and recommends remedial activities. A report on the CAP is then sent to the

regulatory agency. (3) In most cases, a remedial action plan (RAP) is prepared after the CAP has been approved. It may include further monitoring and testing and conceptual design of a recovery/treatment system. If approved, the system is implemented and operated until acceptable concentrations of contaminants are reached in the affected groundwater. Case studies demonstrate that the extent of investigation and remediation is site specific, varying greatly by the type of contaminant and local hydrology. Regulatory requirements, aesthetic considerations, and public water supply needs are also critical factors. (See also W88-11084) (Author's abstract)
W88-11085

TECHNICAL AND PROCEDURAL CONSIDERATIONS FOR IMPLEMENTING AN UNDERGROUND TANK ABANDONMENT PROGRAM,
RMT, Inc., Madison, WI.
R. J. Robbins.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 18-23, 1 fig.

Descriptors: *Regulations, *Water pollution control, *Florida, *Groundwater pollution, *Underground storage, Storage tanks, Project planning.

Federal, state and local agencies are in the process of promulgating new regulations for the management of underground tanks. Many plants, factories and corporations are electing to consolidate tank use and abandon tanks where age is excessive or the tank is no longer required. In a number of states, tanks may still be abandoned in place or by complete removal. An approach is described to either of these underground tank abandonment options which separates the abandonment procedure into three tasks: Initial planning, plan implementation, and site closure and documentation. The program discusses and recommends important technical and procedural considerations such as: (1)Preparation of abandonment specifications, (2) Selection of a contractor, (3) Product removal and disposal, (4) Tank cleaning and purging, (5) Surrounding soil screening and laboratory testing, (6) Site closure - uncontaminated and contaminated, (7) Registration of abandoned tanks, and (8)Documentaion report. The results of this analysis should assist underground tank owners considering tank abandonment, and inform them of some of the technical issues which should be considered when planning tank abandonment. The abandonment program also may direct owners in a systematic fashion to a phased approach for selecting a contractor, tank dismantling, remedial action and final closure documentation. (See also W88-11084) (Author's abstract)
W88-11086

COLLECTION AND TREATMENT OF VOLATILE ORGANIC COMPOUNDS FROM AN UPPER WATERBEARING ZONE IN THE SOUTHEASTERN COASTAL PLAIN,
Woodward-Clyde Consultants, Tallahassee, FL.
T. W. Allen, and R. A. Leighton.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 38-43, 1 fig, 2 ref.

Descriptors: *Water pollution treatment, *Chlorinated hydrocarbons, *Groundwater pollution, Aquifers, Water pollution control, Organic compounds, Cleanup, Coastal plains.

Accumulation of various chlorinated hydrocarbons in the ground water as a result of improper storage, repackaging and dispensing activities at a chemical facility in the Southeastern Coastal Plain required the implementation of an immediate remediation program. After an initial site investigation, a groundwater collection and treatment system was designed and constructed to remove volatile organic compounds. Analysis of groundwater samples collected since inception of the collection/treatment system indicates that the system reduced on-site volatile organic compounds from > 7000 ppb to less than 200 ppb. In order to perform desirable and cost-effective remediation at a contaminated site, a holistic approach is recommended. Consideration should begin at the initial stages of source identification and continue into the latter stages of remediation. Operation and maintenance of the selected remediation alternative is critical to meeting the desired objectives of the selected system. (See also W88-11084) (Author's abstract)
W88-11088

WELL CONSTRUCTION TECHNIQUES TO PREVENT INTERAQUIFIER MOVEMENT OF PESTICIDES,
CH2M Hill, Tampa, FL.
For primary bibliographic entry see Field 8A.
W88-11089

NEW APPROACH TO PROTECTION OF SENSITIVE AQUIFERS IN FLORIDA,
Florida State Dept. of Environmental Regulation, Tallahassee.
R. S. DeHan.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 59-69, 3 ref.

Descriptors: *Florida, *Groundwater pollution, *State jurisdiction, *Legislation, Well water, Aquifer management, Storm runoff, Underground storage, Storage tanks, Water transport, Permits.

In response to the need for greater control over groundwater pollution, the state of Florida has drafted the 'Unique Florida Aquifers Rule' otherwise known as the 'G-I rule'. Selected examples of point and nonpoint sources of aquifer contamination, including industrial discharge, domestic wastewater discharge, stormwater discharge, agricultural runoff, underground storage tank leakage and underground waste transport, are discussed. On a long term basis, aquifers and aquifer segments qualifying as G-I will be designated as such and discharge within such areas will be regulated on a case-by-case basis under discharge permits. To implement immediate protective measures, there was general agreement that a zone of protection be established around existing public supply wells within which discharge to groundwater is prohibited or strictly controlled. The rule is undergoing further review through a series of public workshops that were expected to culminate in December 1986 in a public hearing before the Environmental Regulation Commission who would decide whether or not to adopt these drafts as the official rule. (See also W88-11084) (Miller-PTT)
W88-11090

INTERPRETATION OF GROUND WATER MONITORING DATA -- AN INTEGRATED SYSTEMS APPROACH,
AWARE, Inc., West Milford, NJ.
For primary bibliographic entry see Field 7C.
W88-11091

AGRICULTURE AND GROUND WATER QUALITY,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W88-11094

PREVENTION OF SALTWATER INTRUSION THROUGH ARTIFICIAL RECHARGE OF GROUND WATER IN EAST ORANGE COUNTY, FLORIDA,
Dyer, Riddle, Mills and Precourt, Inc., Orlando, FL.
G. C. Hartman, C. W. Drake, and T. A. Prickett.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 517-538, 13 fig.

Descriptors: *Florida, *Groundwater management, *Aquifers, *Artificial recharge, *Saline water intrusion, Saline-freshwater interface, Geohydrology.

In 1984, a water resources investigation of the Deseret Ranches of Florida was conducted to determine the feasibility of effluent disposal on the Deseret properties. Up to 50 mgd of advanced level treated effluent would be received from the Orange County Eastern Regional and Sand Lake Road Plants and the city of Orlando Water Conserv I wastewater treatment plant. It was found that in East Orange county, chloride content of upper Floridan water increased dramatically approaching the St. Johns River. Further study into this phenomenon revealed that this zone of high chloride was centered on a 32 mile reach of the St. Johns River. Geologic data indicates the presence of a structural feature that parallels this zone of high chloride water. It was hypothesized that if freshwater could be injected in the vicinity of the fault, perhaps the thickness of freshwater in the Floridan aquifer could be increased. A problem associated with this is that the Cocoa Bach wellfield is located 8 miles upgradient of the proposed salinity barrier. The Prickett-Lonnquist Aquifer Simulation Model and Random Walk mass transport were used to address these issues. More than 12 feet of head rise is initially predicted. The long term increase in the thickness of the freshwater lens may (1) permit minor withdrawals between the injection field and Cocoa Beach's potable wellfield for agricultural or other uses, and (2) assist in freshwater management (using the areas between the Cocoa wellfield and the salinity barrier). Initial Random Walk results show that a travel time of 550 years can be expected for particles moving from the salinity barrier to the Cocoa Beach wellfield. These initial modeling studies have shown that the salinity barrier concept is viable and that water quality improvements can be expected. Moreover, initial studies indicate that no contaminants can be expected to reach the Cocoa Beach wellfield for many years. If the program is successful in field testing phase (II), it would subsequently enter the Demonstration Project Phase (III) at an estimated 25 MGD level. Phase (IV) is the 50 MGD level full scale program. (See also W88-11084) (Author's abstract)
W88-11116

AQUIFER PROTECTION--ONE WASHINGTON CITY'S EXPERIENCE,
CH2M/Hill, Bellevue, WA.
S. M. Brown, and J. H. Randall.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 25-45. 7 fig, 2 tab, 2 ref.

Descriptors: *Aquifer management, *Renton, *Washington, *Monitoring wells, *Municipal water, *Water pollution sources, Environmental protection, Project planning, Geohydrology, Regulations, Groundwater movement.

In 1983, the City of Renton, Washington, initiated a program to protect an aquifer that provides approximately 85% of its supply. To date, the program has been conducted in three phases. Phase I, the Well Field Protection Study, consisted of the following: hydrogeologic characterization and contaminant migration pathway identification, contaminant source inventory, preventative measure development, and a public information program. Phase II, the Well Field Monitoring Study, was initiated in 1986 with the goal of delineating that portion of the overall aquifer requiring protection (i.e., an aquifer protection area). An aquifer protection area was delineated by installing a series of monitoring wells around the City of Renton well field. Fluctuations in ground water elevations under different well field pumping conditions were measured for a period of 1 year. Phase III, Ordinance Development, was also initiated in 1986. Several of the preventative measures developed in Phase I were incorporated into two ordinances, one for aquifer protection, the other for secondary containment of underground storage facilities. (See also W88-11121) (Author's abstract)
W88-11123

VAPOR EXTRACTION OF ORGANIC CONTAMINATION FROM THE VADOSE ZONE: A CASE STUDY,
Kleinfelder (J.H.) and Associates, Sacramento, CA.
K. E. Zenobia, D. K. Rothenbaum, S. B. Charjee, and E. S. Findlay.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 625-646. 10 fig, 11 ref.

Descriptors: *Soil contamination, *Water pollution treatment, *Vadose zone, *Vapor extraction, *Decontamination, *Soil gases, *Soil treatment, *Gasoline, Groundwater pollution, Cleanup, Organic compounds, Case studies, Ventilation.

An induced draft vadose zone extraction system was designed and installed to remediate in-situ soil contaminated by a leaking underground storage tank at a winery in the Central Valley, California. The system has successfully extracted gasoline vapor trapped within the subsurface soil matrix. Soil borings and ground water monitoring wells were installed to determine the extent of contamination. A vapor extraction system was selected as a viable remediation alternative based on site geologic and contaminant conditions and a preliminary evaluation of acceptable alternatives. A vapor extraction well (VEW) was installed in the immediate vicinity of the tank and three air inlet piezometers were installed at 5-, 10-, and 20-foot distances from the VEW. A waterseal-type vacuum pump was used for vapor extraction. Static pressure profile in the vadose zone, total pressure at the inlet and outlet of the vacuum pump, temperature, hydrocarbon concentration (ppmv) and volumetric flowrates were recorded at regular intervals. The flowrate and static pressure were regulated to measure their parametric sensitivity on the overall extraction efficiency of the system. A depth-integrated equation was developed based on hydrocarbon concentration profiles from soil borings to estimate the total amount of gasoline present in the vadose zone before and after the soil venting experiment. This paper compared the actual rate of venting of gasoline from the subsurface soil and the total calculated mass remaining in the soil. With proper design, induced soil venting is cost-effective remedial alternative for removing hydrocarbon spills in the vadose zone. Cost were reduced by $100,000 using this method as opposed to conventional excavation, removal and treatment or disposal. (See also W88-11121) (Author's abstract)
W88-11153

UNIQUE CLEANUP SOLUTION TO POLYCYCLIC AROMATIC HYDROCARBON CONTAMINATION FROM A 19TH CENTURY COAL GASIFICATION PLANT,
Hart Crowser, Inc., Seattle, WA.
M. Utting, and O. R. George.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 647-661. 5 fig, 3 ref.

Descriptors: *Aromatic compounds, *Soil contamination, *Cleanup, *Industrial wastes, *Hydrocarbons, *Groundwater pollution, *Decontamination, *Coal gasification, Waste storage, Solid waste disposal, Trace metals, Hazardous materials.

Geotechnical exploration for construction of the Tacoma Spur Freeway SR-705 revealed unexpected contamination. Extensive coal tar waste and ground water contamination resulted from the demolition and burial of a coal gasification plant. Polycyclic aromatic hydrocarbons (PAH) and associated trace metals were found. The subsurface materials to be removed were divided into 'extremely hazardous', 'problem', and 'solid' wastes under Washington State Law (WAC 173-303). A cooperative approach between the Washington State Department of Ecology and the Washington State Department of Transportation produced a solution to waste cleanup that included unique, on-site, concrete-lined storage vaults; after nearby landfills refused to accept the liability of the 'problem waste'. In addition, more than 15,900 tons of 'extremely hazardous waste' were removed to the Arlington Hazardous Waste Facility. The volume, combined with the 'problem waste' represented a removal of an estimated 95 percent of the coal tar contaminants on the site. Total cleanup cost more than $5 million. Long-term ground water monitoring is expected to show a significant decrease in ground water contaminant concentrations reaching the adjacent City Waterway. The cooperative approach has resulted in a timely cleanup and minimal delay to the $100 million construction project. (See also W88-11121) (Author's abstract)
W88-11154

SMALL SCALE RECOVERY OF HYDROCARBONS IN GROUND WATER: A CASE STUDY,
Smith (Roger N.) Associates, Inc., Portland, OR.
R. N. Smith, and P. Scoles.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 663-674. 2 ref, 4 fig.

Descriptors: *Soil contamination, *Decontamination, *Gasoline, *Underground storage, *Cleanup, *Skimming, *Pumping, Leakage, *Groundwater pollution, Soil water, Hydrocarbons, Case studies.

In the spring of 1986, at a routine fuel station construction site, an underground storage tank was accidentally punctured and 967 gallons of gasoline leaked in the tank excavation pit. Small scale gasoline recovery techniques were utilized to remove the fuel which had contaminated the backfill material around the storage tanks, the native soil, and the shallow ground water. The recovery activities were divided into four phases (Initial Response and High Volume Gasoline Recovery, Small Volume Gasoline Recovery, Gasoline Removal by Automated Skimmer, and Dissolved Hydrocarbon Removal) that each addressed certain priorities at the time of implementation. The first phase focused on containment of the spilled fuel and activities to recover the highest quantity of gasoline in the shortest amount of time. In two and a half days, 525 gallons were recovered. For the second phase a small fuel pump and 15 foot wand were used to skim fuel off an exposed pool of gasoline. An 11.5 foot deep cement cistern-type well was constructed to create a permanent gasoline recovery location and permit the local builder to complete station construction. An additional 40 gallons of fuel were recovered as the floating product thickness dropped from 1 inch to less than 0.5 inch. The third phase utilized an automated gasoline skimmer and ground water depression pump. Another 20 gallons of gasoline were recovered, and the visible product thickness decreased to an immeasurable sheen. The fourth and final phase successfully reduced the dissolved benzene, toluene, and xylenes concentration in the ground water from more than 31.0 parts per million to below detection limits using conventional air stripping equipment. After one year, 60.5% of the leaked fuel was recovered. (See also W88-11121) (Author's abstract)
W88-11155

RESTORATION OF WATER RESOURCES AFTER CYANIDE CONTAMINATION: A CASE STUDY,
HWS Technologies, Inc., Lincoln, NE.
R. W. Elliott, and D. W. Thomssen.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 675-694. 4 fig, 3 tab, 2 ref.

Descriptors: *Water quality management, *Water supply, *Cyanide, *Stream pollution, *Monitoring, *Cleanup, Groundwater pollution, Interagency cooperation, Water pollution treatment, Waste disposal, Decontamination.

A program to restore the water resources of Elk City, Idaho (population 450) was instituted after its water supply (Big Elk Creek) was threatened by cyanide. Excursion of cyanide resulted from failure of a heap leach gold recovery facility. The program included an investigation phase, a remediation phase, and closure phase. The program began in March, 1984, and is now (December, 1986) in the final stages of closure. The investigation phase included hydrogeologic, engineering, chemical and feasibility investigation; the establishment of a sampling and monitoring program; and the coordination with the varying and sometimes differing concerns and control of several regulatory agencies including EPA, Idaho Department of Health and Welfare, and Bureau of Land Management. The remediation phase included installation of alternate temporary water supply; surface water management including the construction of ditches and ponds to control site liquids; treatment of site fluids containing cyanide and heavy metals; disposal of treated fluids by land application; continued involvement and problem solving by regulatory agencies; and continuation and modification of sampling and monitoring program. The closure phase included decontaminating the heap materials and site soils; discontinuing the temporary water supply; continuing sampling and monitoring with long-term objectives; encapsulating the heap materials; and site restoration including final grading and seeding; and approval of closure by regulatory agencies. The program was performed in a remote area under extreme weather conditions which require innovative solutions to hold down costs. The resultant economics enabled the responsible party to carry the program to completion. (See also W88-11121) (Author's abstract)
W88-11156

REMEDIATION AT A MAJOR SUPERFUND SITE, WESTERN PROCESSING, KENT, WASHINGTON,
HDR Infrastructure, Inc., Seattle, WA.
K. A. Lepic, A. R. Foster, S. M. Testa, and J. E. Bruya.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 695-719. 10 fig, 1 tab, 1 ref.

Descriptors: *Soil contamination, *Industrial wastes, *Cleanup, *On-site tests, *Chemical wastes, *Waste dumps, *Groundwater pollution, Decontamination, Soil tests, Hazardous materials, Waste identification, Chemical analysis, Pollutant identification.

Western Processing is a former industrial waste processing and recycling facility and major superfund site located in Kent, Washington. 73 contaminants were found in soil samples, and 46 priority pollutants, including both metal and organics, in groundwater samples. The site is underlain with sand, gravel, silt and clay, and the water table is encountered at shallow depths ranging from three to twelve feet below ground surface. An extensive and unique field program was developed and implemented in the fall of 1986 to evaluate the nature and extent of on-site and off-site contaminants for design of remediation measures. Magnetometer/gradiometer (MAG), electromagnetic induction (EM), and ground penetrating radar (GPR) were utilized in an extensive geophysical survey of the site. EM terrain conductivity and inphase component maps, total magnetic field and vertical gradient maps, and radar target maps were subsequently developed. A composite of these maps supplied the location and characterization of subsurface anomalies. Geophysical results were successfully used to guide the soil sampling program. An on-site laboratory was set up, and over 1,500 samples were analyzed for 26 different chemical parameters. The parameters list included total cyanide, metals, volatile organics, and semi-volatile organics. Turnaround time was 24 hours. In addition, several screening methods were developed specifically for contaminants encountered at the site. Positive agreement was obtained when the screening results were compared to the results reported by the off-site laboratories using EPA Contract Laboratory Procedures. (See also W88-11121) (Author's abstract)
W88-11157

QUALITY ASSURANCE FOR ENVIRONMENTAL MEASUREMENTS.
For primary bibliographic entry see Field 7C.
W88-11158

DETERMINATION OF MEASUREMENT DATA QUALITY AND ESTABLISHMENT OF ACHIEVABLE GOALS FOR ENVIRONMENTAL MEASUREMENTS,
Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.
For primary bibliographic entry see Field 7C.
W88-11162

QUALITY ASSURANCE AS AN ELEMENT OF WISCONSIN'S NPDES PROGRAM,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5D.
W88-11169

PULP AND PAPER INDUSTRY EXPERIENCE WITH NPDES QUALITY ASSURANCE REQUIREMENTS,
National Council of the Paper Industry for Air and Stream Improvement, Inc., Gainesville, FL.
For primary bibliographic entry see Field 7C.
W88-11171

MONSANTO ANALYTICAL TESTING PROGRAM FOR NPDES DISCHARGE SELF-MONITORING,
Monsanto Research Corp., St. Louis, MO.
For primary bibliographic entry see Field 7C.
W88-11172

CLASS V INJECTION WELL INVENTORY AND ASSESSMENT, TEXAS,
Texas Water Commission, Austin.
For primary bibliographic entry see Field 5E.
W88-11190

CONTAMINANT-RESISTANT SLURRY TRENCH,
McBride-Ratcliff and Associates, Houston, TX.
W. R. Tobin, and P. R. Wild.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 193-208, 9 fig, 1 tab, 21 ref.

Descriptors: *Water pollution prevention, *Groundwater barriers, *Texas, *Groundwater pollution, *Water pollution control, *Trenches, *Slurries, Waste disposal, Path of pollutants, Clay minerals, Attapulgite, Bentonite, Backfill, Electrolytes, Cations, Permeability, Contamination, Chlorinated hydrocarbons, Saline water, Contamination.

The first soil-attapulgite slurry trench cutoff constructed in the U.S. was designed to withstand the saline groundwater of the Texas Gulf Coast and long-term geochemical degradation from chlorinated hydrocarbon compounds. Batch settling tests indicate that a dispersed attapulgite slurry is more stable than hydrated bentonite upon contact with fluids with a low dielectric constant, a high electrolyte concentration, or multivalent cations. Long-term compatibility tests indicate durable attapulgite backfill permeability characteristics when exposed to saturated chlorinated hydrocarbon compounds. (See also W88-11182) (Author's abstract)
W88-11196

APPLICATION OF MULTIPLE JET PUMPS FOR GROUND WATER RECOVERY,
Kindle, Stone and Associates, Inc., Longview, TX.
W. T. Winn, and E. R. Henderson.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 209-217, 4 fig, 2 ref.

Descriptors: *Groundwater pollution, *Water pollution treatment, *Wells, *Pumps, *Hydraulic equipment, *Groundwater recovery, Path of pollutants, Hazardous materials.

The well pumping system is an essential part of any groundwater recovery system. Use of jet pump technology provides a low cost, effective method for recovery well pumping. A multiple jet pump system employs a single centrifugal pump to provide power fluid to a jet pump installed in each of any number of recovery wells. The combined power fluid and groundwater discharged by the jet pumps flows to a return tank, thence to the suction of the centrifugal pump, completing a recycle loop. Water is withdrawn from the loop for treatment and disposal from the centrifugal pump discharge piping. The multiple jet pump system offers the following advantages: (1) Simplicity of construction with associated low initial cost. There is only one moving part, the centrifugal pump, in the entire system. (2) The pumping rate for each jet pump can be hydraulically controlled to achieve a constant drawdown of the groundwater level. Electrical power and control are not required at the wells. (3) The jet pumps are not damaged by running dry. The system can be installed completely below ground for freeze protection. (4) There are essentially no limits on drawdown achievable with jet pumps. They are applicable to shallow and deep wells. A multiple jet pump system was placed into operation one year ago at a hazardous waste site and is successfully operating at this time. The concept shows a great deal of promise for future applications. (See also W88-11182) (Author's abstract)
W88-11197

MULTI-PURPOSE APPROACH TO GROUND WATER MANAGEMENT,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
For primary bibliographic entry see Field 4B.
W88-11202

LEAKING UNDERGROUND STORAGE TANKS: WHAT IS REQUIRED; WHAT IS REALISTIC,
IT Corp., Houston, TX.
R. S. Newton.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 349-356, append.

Descriptors: *Water pollution control, *Underground storage, *Storage tanks, *Regulations, *Legislation, *Groundwater pollution, Contamination, Path of pollutants, Oil tanks, Leakage, Hazardous materials.

The 1984 Resource Conservation and Recovery Act amendments include a new subtitle mandating a comprehensive regulatory program for underground tanks (Subtitle I, Section 9001-9010). This legislation will serve to expand investigation and remedial action studies relative to leaking underground storage tanks from isolated states into a nationwide program. These tanks are in or above the groundwater, and therein lies the potential problem and the basic reason for regulatory legislation. Regulation highlights are briefly reviewed, including significant requirements and dates relating to the 3-step approach ususally taken by state and local regulations. These steps are: (1) notification and registration; (2) leak detection investigation; and (3) leak prevention and monitoring. Enforcement of the regulations varies from state to state and locality to locality. (See also W88-11182) (Sand-PTT)
W88-11206

INDUSTRY'S RESPONSE TO I.U.S.T. REGULATIONS IN FLORIDA AND RECOMMENDATIONS FOR APPLICATION OF AVAILABLE TECHNOLOGIES,
Environmental Science and Engineering, Inc., Gainesville, FL.
M. McCarthy.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 357-363, 6 ref.

Descriptors: *Water pollution control, *Underground storage, *Storage tanks, *Regulations, *Groundwater pollution, Contamination, Path of pollutants, Leakage, Hazardous materials, Monitoring, Data collection, Monitoring wells, Florida.

Underground storage tank regulations in Florida have been promulgated by three government bodies: Broward County, Dade County, and the State, of Florida. These regulations, potential precursors of upcoming federal regulations, rely primarily upon tank integrity protection and leakage detection systems to ensure groundwater quality. The effective portions of these regulations require tank registration and leakage detection systems. The leak detection regulations, which require detection within and outside the product distribution system, include inventorying procedures, pressure testing, and integral piping leak detectors. External leak detection systems consist of monitor wells either equipped with automatic sensing devices or manually monitored on a regular basis. The compliance strategies used by industry to conform with these regulations represents a cross-section of available technology. The various industry responses and technologies used across Florida are discussed. Technologies and procedures described in detail include automated and manual inventory data collection, integral piping leak detection systems, pressure testing, and groundwater monitoring systems. The advantages and disadvantages of the various options are discussed and recommendations provided for appropriate application of available technologies. (See also W88-11182) (Author's abstract)
W88-11207

UNDERGROUND FUEL STORAGE SECONDARY CONTAINMENT: THE SOUTH FLORIDA EXPERIENCE,
Seaman Corp., Millersburg, OH.
F. R. Wilson.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 364-377, 12 fig, 2 tab, 1 ref.

Descriptors: *Lining, *Water pollution control, *Regulations, *Underground storage, *Storage tanks, *Groundwater pollution, Contamination, Path of pollutants, Hazardous materials, Containment, Legislation, Florida, Aquifers.

Dade and Broward Counties in Southeast Florida were among the first areas in the U.S. to implement Secondary Containment legislation. The protection of the Biscayne Aquifer, a sole source water supply, was the primary reason for this legislation. Most secondary containment systems have used fuel-resistant flexible membrane liner systems, which have developed alternative methods of installation as needed to cope with subsurface conditions in Southeast Florida. Regulatory progress is reported to be steady and effective. (See also W88-11182) (Author's abstract)
W88-11208

TRENDS IN GROUND WATER LAW IN THE CAROLINAS AND VIRGINIA: 1985,
North Carolina Univ. at Chapel Hill. Inst. of Government.
For primary bibliographic entry see Field 6E.
W88-11209

PROCEEDINGS OF THE NWWA/API CONFERENCE ON PETROLEUM HYDROCARBONS AND ORGANIC CHEMICALS IN GROUND WATER: PREVENTION, DETECTION AND RESTORATION.
National Water Well Association, Dublin, OH. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. 811 p.

Descriptors: *Hydrocarbons, *Oil pollution, *Groundwater pollution, *Aquifer management, *Plumes, *Path of pollutants, *Monitoring, *Remedies, Hydrogeology, Risks, Case histories, Technology, Organic compounds, Petroleum products.

The NWWA/API Conference and Exposition on Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration, was held in Houston, Texas, on November 12-14, 1986. The conference covered a wide range of topics including prevention of ground water contamination from underground storage tanks, migration of petroleum hydrocarbons and organic chemicals in ground water, characterizing contaminant transport in the vadose zone, physical and chemical processes in the subsurface, utilizing remote sensing for detecting and delineating subsurface contamination, monitoring and analytical techniques for contaminant identification, characterizing subsurface geology and mapping contaminant movement, detection of volatile organic chemicals in ground water, remedial action planning and risk assessment, innovative applications of new and established technologies for remedial action and case histories. (See W88-11214 thru W88-11260) (Author's abstract)
W88-11213

NEW APPROACHES TO THE EVALUATION OF LEAK DETECTION MONITORS FOR UNDERGROUND STORAGE TANKS,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11214

SOME EUROPEAN PERSPECTIVES ON PREVENTION OF LEAKS FROM UNDERGROUND PETROLEUM STORAGE SYSTEMS,
Maine Dept. of Environmental Protection, Augusta.
M. Moreau.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 21-29.

Descriptors: *Underground storage, *Europe, *Leakage, *Groundwater pollution, *Water pollution control, Pumps, Design standards, Environmental management, Petroleum products.

This paper discusses some of the common aspects among European tank management strategies, including (1) all storage facilities must meet the same requirements, regardless of ownership or use; (2) Asphaltic coatings for steel tanks are common, and, except in the Netherlands, cathodic protection is not routinely required; (3) outside-the-tank leak detection technology is virtually unknown; (4) fiberglass tanks are not commonly used at marketing and distribution facilities; (5) suction pumping systems at retail installations are preferred because they can be made intrinsically safe against environmental damage; (6) all underground tanks have manholes and all piping enters through the manhole lid, allowing easy inspection of tank/piping connections; and (7) overfill protection measures of some type are common. Of the countries surveyed, West Germany has the best developed and most aggressive underground taken regulatory program and appears to have the problem largely under control. Key elements of the German strategy are described. (See also W88-11213) (Author's abstract)
W88-11215

MTBE AS A GROUND WATER CONTAMINANT,
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 5B.
W88-11227

ROLE OF GEOLOGIC CHARACTERIZATION IN DETERMINING MIGRATION OF HYDROCARBON SPILLS: A CASE STUDY,
EMCON Associates, San Jose, CA.
S. M. Willhite, E. D. Garner, and C. C. Stanley.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 343-356, 6 fig, 1 tab, 7 ref.

Descriptors: *Geology, *Groundwater pollution, *Path of pollutants, *Fracture permeability, *Geologic fractures, *Oil spills, Bedrock, Hydrocarbons, Geohydrology, Remedies, Gasoline, Plumes, Seepage, California, Underground storage, Remedies.

Investigation and remediation of a subsurface hydrocarbon spill was initiated at a service station in Santa Cruz, CA, when gasoline was discovered in a subsurface utility vault located next to the site. Observation wells were placed adjacent to the tank complex to determine the concentrations of hydrocarbon that were migrating off-site. The data from the wells showed that the only places where relatively high gasoline concentrations or pure product were observed in the ground water were in the tank adjacent to the site, in the underground utilities adjacent to the site, at the seepage face, and in the fractures that were noted in the exploratory trenches and along the seepage face. All of these areas were located along a fracture zone, indicating that fractures are the primary pathway along which petroleum products migrate. Remedial action alternatives under consideration included an infiltration trench placed across the fracture system immediately upgradient of the seep face and a shallow dewatering trench upgradient of the site to passively alleviate artesian conditions during the rainy season. (See also W88-11213) (Author's abstract)
W88-11234

EVALUATION OF A PASSIVE SAMPLING SOIL-GAS SURVEY TECHNIQUE FOR DETECTING VOLATILE ORGANIC COMPOUNDS,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11237

DISPOSAL OF HYDROCARBON CONTAMINATED SOIL,
Applied Earth Sciences, Inc., Houston, TX.
For primary bibliographic entry see Field 5E.
W88-11240

LOOK BEFORE YOU LEAP: THE CASE FOR RESTRAINT FROM ACTIVE SITE REMEDIATION,
Environmental Resources Management, Inc., West Chester, PA.
For primary bibliographic entry see Field 6B.
W88-11241

AQUIFER RESTORATION: COMPREHENSIVE ADDRESS TO ORGANIC CHEMICAL CONTAMINATION,
P. M. Yaniga.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 487-538, 32 fig, 1 tab.

Descriptors: *Groundwater pollution, *Aquifer management, *Management planning, *Wastewater pollution treatment, *Remedies, *Organic compounds, *Evaluation, Leachates, Adsorption, Water quality control, Cleanup operations, Underground storage.

Of the many aquifers contamination problems, old dump sites and leaking underground storage tanks, which discharge organic chemicals, are considered to be of greatest public concern or at least most noteworthy. In addressing leaks and losses of organic chemicals to groundwater, it must be recognized first that it can and often is a four-phase problem. In analyzing the problem and providing for its address the adsorbed phase, dissolved phase, phase separated, and vapor phase, organics must be considered and accommodated for in the development of a comprehensive aquifer restoration project. This paper provides insight into the mechanisms of evaluation and successful application of in situ technology that addresses the four phases of organic contamination in restoring aquifer quality. (See also W88-11213) (Author's abstract)
W88-11242

UNDERGROUND FUEL CONTAMINATION, INVESTIGATION, AND REMEDIATION: A RISK ASSESSMENT APPROACH TO HOW CLEAN IS CLEAN,
EA Engineering, Science, and Technology, Inc., Lafayette, CA.
R. E. Hinchee, H. J. Reisinger, D. Burris, B. Marks, and J. Stepek.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 539-564, 3 fig, 3 tab, 44 ref.

Descriptors: *Risks, *Public health, *Population exposure, *Remedies, *Water pollution treatment, *Oil, *Groundwater pollution, *Cleanup operations, Long-term planning, Soil contamination, Geohydrology, Gasoline, Fossil fuels.

This paper describes the application of risk assessment to a fuel contaminated site to (1) document that risk to human health and the environment have been evaluated and given consideration in determining the appropriate response and (2) to provide a rational approach to determining the appropriate level of effort for investigation and remediation of the site. Steps described in the risk assessment process include site characterization, hazard identification, fate analysis, exposure assessment, risk determination, and risk management. Among the factors to be considered in the process are toxicity of the pollutants, fate and transport, vapor phase transport, groundwater transport, and hydrogeological features. The risk assessment process is a mechanism utilizes the best available scientific and engineering knowledge ot establish site-specific response levels that will result in achieving the goal of assuring that the most cost-effective solution is identified. In its application to subsurface fuel spill sites a risk assessment need not be a lengthy or expensive process, since such sites tend to present similar problems and much is known about risks presented by fuel contamination. (See also W88-11213) (Friedmann-PTT)
W88-11243

'REALISTIC' COST ESTIMATES FOR ALTERNATIVE REMEDIAL ACTIONS OF CONTAMINATED, UNSATURATED SOILS AND UNDERLYING AQUIFERS,
Canonie Environmental Services Corp., San Mateo, CA.
For primary bibliographic entry see Field 6E.
W88-11244

CONSIDERATIONS FOR OPTIMIZATION OF ABATEMENT SYSTEM DESIGN,
Groundwater Technology, Inc., Chadds Ford, PA.
For primary bibliographic entry see Field 6A.
W88-11245

SWAPS, AN AUTOMATED LIQUID HYDROCARBON RECOVERY SYSTEM,
Amoco Corp., Tulsa, OK.
L. E. Dunlap.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 607-612, 3 fig.

Descriptors: *Waste recovery, *Hydrocarbons, *Immiscibility, *Groundwater pollution, *Water pollution treatment, *Cleanup operations, Pumps, Plumes, SWAPS system, Leakage, Wells, Observation wells, Trenches.

In many cases, it is feasible to recover immiscible hydrocarbons from two-inch observation wells rather than from a larger diameter recovery well that contains an expensive, double-pump recovery system. Examples include situations where immiscible hydrocarbons may be present in only one or two observation wells, where the quantities of leaked or spilled hydrocarbons are suspected to be minimal, or in relatively impermeable aquifers where recovery operations can be accomplished by pumping from several closely spaced observation wells in lieu of a combination trench/well recovery system. This paper describes an inexpensive Shallow Well Automatic Pumping System (SWAPS), developed by the Groundwater Management Section, Amoco Corporation. SWAPS is capable of pumping total fluids (ground water and immiscible hydrocarbons) from observation wells. The cost of SWAPS is significantly less than commercially available recovery system equipment. The system uses a diaphragm pump to lift fluids by suction from individual wells. Each well is pumped sequentially for specified periods of time that are determined by the operator. A limiting factor to utilization of the system is the depth to ground water below the pump. The system operates by creating a vacuum in the suction line that extends down to the well. Thus, the maximum distance of effective lift is limited to 15-17 feet. (See also W88-11213) (Author's abstract)
W88-11247

REMEDIATION OF GASOLINE-CONTAMINATED GROUND WATERS: A CONTROLLED FIELD EXPERIMENT,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
K. Berry-Spark, J. F. Barker, D. Major, and I. Mayfield.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 613-623, 4 fig, 6 ref.

Descriptors: *Groundwater pollution, *Aquifer management, *Gasoline, *Water pollution treatment, *Path of pollutants, *Biodegradation, *Cleanup operations, Injection wells, Petroleum products, Plumes, Aromatic hydrocarbons, Nitrates, Nutrients, Groundwater movement, Injection, Wastewater treatment, Biological wastewater treatment, Simulation, Remedies, Organic compounds.

A field injection experiment is described thatis being carried out in the shallow sand aquifer at Canada Forces Base Borden to evaluate nitrate addition as an in situ measure for remediation of gasoline-contaminated ground water. Of particular concern are the monoaromatic hydrocarbons that are major contaminants in ground waters impacted by gasoline. Two plumes of gasoline-contaminated ground water have been created by injection into the highly-instrumented experimental aquifer. Immediately upgradient of one plume, ground water spiked with nitrate has been added so that the slightly retarded organic contaminants, travelling at 65% to 90% of the ground water velocity, will be overtaken by the added nitrate that migrates at the ground water velocity. This experiment was continuing into mid-1987. The results of the laboratory biotransformation experiments with Borden sand and ground water, and the results of preliminary mathematical simulation of organic and nitrate migration and interaction are consistent with the early results of the field experiment. (See also W88-11213) (Author's abstract)
W88-11248

TREATMENT OF CONTAMINATED GROUND WATER WITH MEMBRANE SEPARATION TECHNOLOGIES,
C3 International, Minneapolis, MN.
K. T. Finkenbiner.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 624-630.

Descriptors: *Water pollution treatment, *Groundwater pollution, *Cleanup operations, *Filtration, *Reverse osmosis, *Semipermeable membranes, Wastewater treatment, Technology, Design criteria, Aquifer management.

This paper summarizes the membrane technologies commercially available for the treatment of waste waters, discusses system design considerations and presents case histories. Membrane separation technologies reviewed in this paper include microfiltration, which involves the removal of particulate or suspended materials ranging in size from 0.1 to 10 microns, ultrafiltration, which is used to separate materials in the 0.001 to 0.1 micron range, and reverse osmosis, which is typically used to separate materials less than 0.001 microns. Reverse osmosis offers the advantage of rejecting ionic materials that are normally small enough to pass through the pores of the membrane. As with ultrafiltration, reverse osmosis is used to remove dissolved materials. (See also W88-11213) (Author's abstract)
W88-11249

HYDROGEOLOGIC ASSESSMENT, DELINEATION, AND REMEDIATION OF A SHALLOW GROUND WATER CONTAMINATED ZONE,
CIBA-GEIGY Corp., St. Gabriel, LA.
M. M. Fontenot.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 633-653, 12 fig, 4 ref.

Descriptors: *Geohydrology, *Groundwater pollution, *Cleanup operations, *Shallow water, *Monitoring, Organic compounds, Hazardous materials, Sampling, Monitoring wells, Plumes, Louisiana, Path of pollutants, On-site data acquistions, Underground storage.

This paper details a case history of a ground water contamination episode and the subsequent corrective action. A ground water monitoring system was installed in December 1981, in the vicinity of several hazardous waste facilities. Ground water samples collected and analyzed from a well adjacent to a by-product hydrochloric acid storage tank during the second quarter of 1984 showed carbon tetrachloride and chloroform concentrations that exceeded 0.01 ppm, 11 feet below land surface (ft bls). Resampling and subsequent analysis confirmed the presence of these two EPA defined priority pollutants in concentrations of: CHCl3 - 100 ppb and CCl4 - 50 ppb. A ground water quality assessment program was designed and implemented to determine the rate and extent of migration of the two constituents. The ground water quality assessment program was designed to adequately define the vertical and horizontal extent of the contaminant plume. A series of monitoring wells was installed in the vicinity of the tank in three different zones. A total of 28 monitoring wells were installed, four of which were inclined at 45 degrees to monitor ground water quality beneath the tank. Water quality data from the well showed the plume of contamination to be confined to an area of approximately 10,000 sq ft. The highest levels of CCl4 and CHCl3 detected were 5 ppm and 10 ppm, respectively. The hydrogeological data was used to formulate a Corrective Action Plan. The plan involves removal fo the tank, piping, associated equipment and contaminated soil down to the water table. The contaminated soil will be disposed of off-site in a commercial hazardous waste landfill. The ground water in the area will be removed via a subsurface drain system and treated in the plant waste water treatment system prior to discharge. The excavated area will be backfilled with clean soils. Natural infiltration will induce flushing of the contaminants to the drains. It is estimated that the clean-up period will be one year. (See also W88-11213) (Author's abstract)
W88-11250

ON-SITE RESTORATION TECHNIQUE FOR THE REMEDIATION OF SOILS CONTAINING HYDROCARBON CONSTITUENTS,
Canonie Environmental Services Corp., Porter, IN.
S. L. Gerken, and B. M. Bell.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 654-671, 3 fig, 2 tab.

Descriptors: *Cleanup operations, *Hydrocarbons, *Organic compounds, *Soil contamination, Aeration, Soil aeration, Activated carbon, Adsorption, Pilot plants, Superfund sites, Maine, Air pollution, Costs, Performance evaluation, Remedies.

Canonie Environmental Services Corp. performed a soil aeration pilot study on behalf of potentially responsible parties at the McKin Superfund Site in Gray, Maine. The purpose of the study was to determine the effectiveness of a materials dryer in the aeration of granular soils to a treatment level that would meet a U.S. EPA-designated performance standard of 0.10 ppm trichloroethylene as an organic indicator in the treated soil mass. The study centered on the utility of a baghouse, packed tower air scrubber, and vapor phase activated carbon adsorption units to control air emissions, while maximizing the production rate of the materials dryer. The study concluded that the treatment method selected could meet the performance standard set by the U.S. EPA. The aeration technique perfected in the study is capable of treating sufficient quantities of granular soil at reasonable costs, which makes the aeration technique economically feasible and technically acceptable in the remediation of sites containing organic and petroleum constituents. (See also W88-11213) (Author's abstract)
W88-11251

SOIL VENTILATION FOR THE REMOVAL OF ADSORBED LIQUID HYDROCARBONS IN THE SUBSURFACE,
Groundwater Technology, Inc., Norwood, MA.
G. V. Batchelder, W. A. Panzeri, and H. T. Phillips.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 672-688, 5 fig, 3 tab, 4 ref.

Descriptors: *Soil contamination, *Cleanup operations, *Venilation, Hydrocarbons, Networks, Ventilation wells, Case studies, Service stations, Leaching, Capillaries, Aeration zone, Economic aspects.

Soil ventilation is often an effective, cost-saving approach to decontaminating soil. The basic principal is that liquid hydrocarbons will vaporize to a state of equilibrium in the air spaces that surround soil particles. If the air is not replaced, the hydrocarbons will remain trapped on the surface of the soil particles until leached by percolating water. A testing procedure is described for determining the placement of ventilation well points and determining soil ventilation system efficiency. The procedure for determining the placement of ventilation well points and determining soil ventilation system efficiency. The procedure will help to determine the suitability of a soil venting system for other treatment applications. Actual site histories (former service stations) are used as the basis for the determination of soil ventilation effectiveness for soil remediation and vapor abatement. (See also W88-11213) (Author's abstract)
W88-11252

TREATMENT AND REMOVAL OF DISSOLVED ORGANICS AND INORGANICS IN A CONTAMINATED GROUND WATER - A CASE STUDY,
Stover and Associates, Stillwater, OK.
E. L. Stover, M. M. Gates, and R. Gonzalez.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and

Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 689-708, 8 fig, 3 tab, 5 ref.

Descriptors: *Groundwater pollution, *Aquifer management, *Cleanup operations, *Monitoring wells, *Waste recovery, *Water pollution treatment, Refineries, Feasibility studies, Design criteria, Networks, Pilot plants, Heavy metals, Economic aspects.

A detailed ground water investigative program was performed to define possible contamination problems and extent of contamination at a refinery. The ground water investigative program consisted of developing a network of monitoring wells along with an extensive sampling and analysis program and ground water modeling. Bench-scale and pilot-scale treatability studies were performed to develop feasible and economical treatment processes and to determine precise design parameters for the full-scale water treatment facilities. This paper presents the methodology and test results from the treatability studies that were conducted to develop a preliminary design for the ground water treatment system for aquifer restoration. (See also W88-11213) (Author's abstract)
W88-11253

VACUUM ENHANCED HYDROCARBON RECOVERY: A CASE STUDY,
Engineering Enterprises, Inc., Norman, OK.
S. B. Blake, and M. M. Gates.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 709-721, 5 fig, 4 ref.

Descriptors: *Waste recovery, *Groundwater pollution, *Hydrocarbons, *Hydraulic gradient, *Vacuum filtration, Case studies, Remedies, Groundwater movement, Wells, Plumes, Cleanup operations.

Case studies as presented that demonstrate significant increases in hydrocarbon recovery rates through the use of vacuum enhancement. The use of vacuum systems to enhance the such a recovery is an effective remediation procedure. Vacuum enhanced recovery involves the application of a vacuum to a single well or well point system. This procedure is capable of increasing the capture zone and rate of recovery for a given well or well system by increasing the hydraulic gradient. Thus, the number of wells required to remove a given spill and the time of operation of the system can both be reduced. With an increased hydraulic gradient produced by vacuum application, the recovery of mobile hydrocarbons is enhanced. In addition, some of the hydrocarbons that would have otherwise been retained in the formation as residual saturation are freed to flow into the well due to the increased relative gradient by the vacuum. (See also W88-11213) (Author's abstract)
W88-11254

OCCURRENCE AND RECOVERY OF A DNAPL IN A LOW YIELDING BEDROCK AQUIFER,
Environmental Resources Management, Inc., West Chester, PA.
J. P. Ferry, P. J. Dougherty, J. B. Moser, and R. M. Schuller.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 722-733, 4 fig, 1 ref.

Descriptors: *Groundwater pollution, *Aquifer management, *Waste recovery, *Groundwater movement, Subsurface drainage, Monitoring, Observation wells, Hydrostatic pressure, Upconing, Plumes.

A heavier than water Non-Aqueous Phase Liquid (DNAPL) was encountered during the installation of monitoring wells in a low-yielding bedrock aquifer. Two tests were conducted to establish (1) whether or not natural ground water flow and gravity drainage could produce a free DNAPL interface in the well, and (2) to determine if an upconing of DNAPL would occur if the hydrostatic head within the well was reduced. Results of the testing showed that a simple, gravity-based recovery system would not result in effective DNAPL recovery. Enhanced ground water flow via pumping through secondary porosity features induces the flow of DNAPL into the borehole. The reduction of the hydrostatic head within the well results in the upconing of DNAPL. (See also W88-11213) (Friedmann-PTT)
W88-11255

DESIGN AND IMPLEMENTATION OF A GROUND WATER REMEDIATION PROGRAM AT LOUISIANA'S PRIORITY SUPERFUND SITE,
IT Corp., Baton Rouge, LA.
For primary bibliographic entry see Field 2F.
W88-11256

ADVANCED STAGES OF A HYDROCARBON RECOVERY/CLOSED LOOP HYDROCARBON FLUSHING SYSTEM SUCCESSFUL IN A HIGHLY PERMEABLE GLACIAL OUTWASH IN APPLE VALLEY, MINNESOTA,
Leggette, Brashears and Graham, Inc., St. Paul, MN.
S. M. Lapham.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 755-769, 6 fig.

Descriptors: *Injection wells, *Waste recovery, *Groundwater pollution, *Oil spills, *Cleanup operations, Performance evaluation, Glacial aquifers, Minnesota, Hydrocarbons, Petroleum products, Plumes, Sediments.

The use of injection wells in the recovery process is described after corrosion pits and a catastrophic roof collapse on two separate petroleum storage tanks resulted in a loss of 9,000 barrels of No. 2 fuel oil from one tank and an unknown volume of leaded gasoline from the other tank. The injection system is a unique methodology that is effective in the removal of free and soluble hydrocarbon product from unsaturated sediments that would otherwise have been very difficult to recover. Injection has also helped to solve the problems associated with discharge water disposal. THe present recovery well, water treatment, injection well configuration and maintenance procedures provide operational flexibility to the system, making it possible to maintain the optimum pumping rates at the recovery wells and the injection wells, thus enhancing the overall recovery program. (See also W88-11213) (Author's abstract)
W88-11257

SHP PUMPS - A NEW APPROACH TO THE RECOVERY OF SUBSURFACE PETROLEUM HYDROCARBONS,
Templar Associates Ltd., Blacksburg, VA.
J. G. Agar, S. K. Ray, and W. R. Allan.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 770-784, 14 fig.

Descriptors: *Pumps, *Wastewater recovery, *Groundwater pollution, *Hydrocarbons, *Cleanup operations, Petroleum products, Case studies, Economic aspects, Geohydrology, Performance evaluation, Aquifer management.

Slim hole piston (SHP) pumps have been installed in small diameter recovery wells to abstract immiscible hydrocarbons (both floaters and sinkers) and contaminated ground water from shallow aquifers in a range of hydrogeologic settings. This paper documents a case history in which SHP pumps are being used to recover relatively large volumes of petroleum hydrocarbons from the subsurface at a refinery site. The case history illustrates ground water restoration techniques that are comparatively inexpensive and provide considerable operational flexibility. Special hydrogeologic features of the site are described and the rationale for design of the containment and recovery facilities are outlined. The performance of the recovery facilities to date is reviewed and the advantages and limitations of SHP pumps for this application are discussed. The case history shows that SHP pumps have the demonstrated capability to effectively recover immiscible petroleum hydrocarbons and chemicals from contaminated aquifers. The pumps require very little maintenance and are constructed to withstand corrosive organic chemicals and acids. (See also W88-11213) (Author's abstract)
W88-11258

IMPLEMENTATION OF A HYDRAULIC BARRIER UTILIZING AN EXTRACTION AND INJECTION WELL SYSTEM,
EMCON Associates, San Jose, CA.
J. N. Batchelder, and W. M. Crell.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 785-796, 7 fig, 3 ref.

Descriptors: *Barriers, *Groundwater barriers, *Oil spills, *Water pollution control, *Groundwater pollution, *Path of pollutants, Plumes, Remedies, Cleanup operations, Design criteria, Hydraulic structures, California, Service stations, Computer models, Seasonal variation.

A 14,000-gallon petroleum product loss occurred at a service station in San Mateo County, Calif. This paper describes investigations to determine the horizontal extent of the migration of the product and to design and implement a remedial-action system to control and remove the product. A series of extraction wells situated at the downgradient extent of the plume. System design was affected by residential structures, alluvial geology and discharge restrictions imposed by local regulatory agencies. A simple semi-analytic computer model was used in conjunction with aquifer testing to aid in optimal well placement for maximum product capture. Results of this study led to proposing installation of an injection system downgradient of the extraction system cause a reverse gradient beyond the hydraulic barrier, to lessen the effect of seasonal fluctuations, and to aid in compliance with ground water discharge restrictions. (See also W88-11213) (Author's abstract)
W88-11259

ASSESSMENT AND MANAGEMENT OF A 15-YEAR-OLD VOC GROUND WATER CONTAINMENT PLUME,
Traverse Group, Inc., Ann Arbor, MI.
J. M. Armstrong, and J. H. Sammons.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 797-811, 10 fig, 6 ref.

Descriptors: *Groundwater pollution, *Hydrocarbons, *Oil, *Cleanup operations, *Water pollution treatment, Plumes, Technology, Hydraulic structures, Wells, Biodegradation, Performance studies, Michigan, Microorganisms, Case histories.

This paper presents a case history and discussion of a Michigan site where the initial fuel-related hydrocarbon contamination occurred in 1969, and remained undiscovered until 1980. The background and nature of the plume and the approach taken to contamination and cleanup are discussed. New air stripping technology and use of a hydraulic well interceptor system to contain the plume is described. Naturally occurring soil microbial consortia produced a rapid, and dramatic, reduction in the hydrocarbon contaminants in some areas of the

plume. The in-situ degradation by bacterial action is one resulting from a well-acclimated bacterial community. The TORVEX catalyst is shown to be effective in the removal of volatile hydrocarbons from the air stream; however, the air stream coming from the stripping operation is saturated with water that had initially caused some problems. These problems are now under control and the incinerator evaluation is progressing into its final phase along with the rotary air stripper. (See also W88-11213) (Author's abstract)
W88-11260

NEW TECHNOLOGY IN OIL CONTENT MONITORS,
Naval Sea Systems Command, Washington, DC.
J. A. Nardella, T. T. Raw, and G. H. Stokes.
Available from the National Technical Information Service, Springfield, VA. 22161, as AD/A183 941. Price codes: A03 in paper copy, A01 in microfiche. 1987. 26 p, 6 fig, 3 tab, 2 append.

Descriptors: *Water pollution prevention, *Oil pollution, *Monitoring, Water quality control, Bilge, Computers, Optical properties, Separation, Oily water, Water pollution concentration.

In response to legislation on international antipollution requirements designed to regulate the oil content of bilge effluent from ships, the U.S. Navy is installing pollution abatement equipment on all vessels. The equipment will consist of an oil/water separator in the bilge discharge line, followed by an oil content monitor which makes the final decision on whether or not the water is clean enough to be pumped overboard. The monitor is required to make a real time measurement of oil concentration in the range 15 + or - 5 to 100 + or - 20 ppm for flow rates up to 50 gal/min and possibly in the presence of interfering contaminants, such as rust. Results of the current effort to develop a monitor which satisfies all these requirements and is sufficiently rugged for fleet deployment. The monitor employs two fiber optic systems and a small microprocessor are presented. The first optical system measures the concentration of particles in the flow as a function of their sizes, using small angle forward scattering. The second determines what percentage of the particles in the flow are oil, using large angle scattering. The microprocessor takes these and calculates the oil concentration in the flow. Since the particle size is measured by the monitor, no sample preparation is required and the monitor may be placed directly in the discharge line where it responds to changes in oil content in less than one second. This monitor can notify the operator of impending oil/water separator failure associated with passing large oil particles. A demonstration monitor consisting of the forward scattering unit has been successfully tested at the NAVSEA oil pollution abatement test facility at the Philadelphia Naval yard. The monitor agreed well with chemical means of measuring oil content. The legislation and regulations applicable to the Navy oil pollution prevention program are given in an Appendix. The theoretical basis for the monitoring equipment is given in a second Appendix. (Lantz-PTT)
W88-11262

QUALITY CRITERIA FOR WATER 1986.
Environmental Protection Agency, Washington, DC.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-226759. Price codes: A18 in paper copy, A01 in microfiche. EPA Report 440/5-86-001, May 1, 1986. 398 p, 15 tab, 208 ref, 3 append.

Descriptors: *Regulations, *Standards, *Water quality standards, Water quality, *Clean Water Act, Environmental effects, Ecological effects, Groundwater quality.

Section 304(a) (1) of the Clean Water Act (33 U.S.C. 1314 (a) (1)) requires the Environmental Protection Agency (EPA) to publish and periodically update ambient water quality criteria. These criteria are to reflect accurately the latest scientific knowledge: (a) on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, aesthetics, and recreation which may be expected from the presence of pollutants in any body of water including groundwater; (b) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and (c) on the effects of pollutants on biological community diversity, productivity, and stability, including information on the factors affecting rates of eutrophication and organic and inorganic sedimentation for varying types of receiving waters. These criteria present scientific data and guidance on the environmental effects of pollutants; they are not rules and do not have regulatory impact. Criteria on 94 water quality parameters (substances, color, pH) are included. (Lantz-PTT)
W88-11267

AERATION AT OVERFLOW WEIRS,
National Board of Waters, Helsinki (Finland).
E. Lakso.
Water and Environmental Research Institute, Helsinki, Finland. 1988. 104 p, 63 fig, 12 tab, 48 ref, 13 append.

Descriptors: *Aeration, *Overflow, *Weirs, Flow profiles, Hydraulics, Water temperature, Seasonal variation, Rivers, River flow, Dissolved oxygen.

The possibilities of using overflow weirs to aerate flowing water is studied. The study was carried out using full-size experimental weirs in which it was possible to regulate the height of the fall, the flow, the depth of the tail water, and the form of the weir crest. The experimental weirs were located immediately below reservoirs, since they were used to improve the oxygen content of water leaving the reservoir. The aeration trials were done in the winter, at which time the water temperature was near O C, as well as in the late summer or early autumn, when the water temperature was near +20 C. The results obtained were compared to those found in studies of various researchers, as well as to comparable data available from overflow weirs, weirs with sloping sides, and natural rapids. In addition, an investigation was made to establish the theoretical basis for aeration phenomena. In this connection, measurements were made of the amount of air carried underwater in the jet and the distance the air travelled underwater. According to the present results, overflow weirs can considerably increase the oxygen content of water, e.g. a fall height of 1 m increased the 1 m increased the dissolved oxygen content of water from 2 mg/L to 6 mg/L, when the water temperature was nearly 0 C. Both deep tail water and the use of different shapes of weir crests improved the aeration results. Increasing the flow generally had a detrimental effect on aeration. (Author's abstract)
W88-11269

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PRESENT AND FUTURE PERSPECTIVES ON WATER RESOURCES IN DEVELOPED COUNTRIES,
Politecnico di Milano (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 6D.
W88-10488

WATER RESOURCES PLANNING AND MANAGEMENT IN ILLINOIS,
Illinois State Dept. of Transportation, Springfield.
D. R. Vonnahme.
The Environmental Professional, Vol 10, No. 1, p 73-79, 1988. 2 tab.

Descriptors: *Resources management, *Planning, *Water resources institutes, *Illinois, *Political aspects, *Administrative Agencies, Water pollution control, Public policy, Water quality control, Groundwater management, Flood control.

The Illinois State Water Plan is described, and how and that state's State Water Task Force has coordinated and implemented many of the Water Plan recommendations. This Task Force continues to use this coordinated planning process in addressing new issues and managing the implementation of the Water Plan. The development of the plan concept, a public participation program, and publications of Task Force are reviewed. Findings and recommendations of the Water Plan are outlined, including those for erosion and sediment control, protection of underground water, flood damage mitigation, and water conservation. Operating issues covered include stream data measurements and stream indexing. The current status of the Water Plan is also described. (Friedmann-PTT)
W88-10632

IMPROVEMENT OF THE MITRE MODEL FOR PRIORITIZATION OF HAZARDOUS WASTE SITE REMEDIATION,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W88-10870

OPTIMUM STRENGTHENING OF DRINKING WATER SUPPLY NETWORKS IN RURAL AREAS: PRELIMINARY PROJECT METHODS (RENFORCEMENT OPTIMUM DES RESEAUX D'ADDUCTION D'EAU POTABLE EN ZONE RURALE METHODES D'AVANT-PROJET),
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Cestas Principal (France). Div. Hydraulique Agricole.
For primary bibliographic entry see Field 5F.
W88-10905

METHODOLOGY AND USE OF INTERFACING REGIONAL AND SUBREGIONAL GROUND WATER FLOW MODELS,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 4B.
W88-10963

SCIENTIFIC CONSIDERATIONS IN THE LEGISLATIVE ARENA,
House, Washington, DC.
For primary bibliographic entry see Field 6E.
W88-10992

SYSTEMS APPROACH TO EVALUATING SALTWATER INTRUSION,
Technos, Inc., Miami, FL.
For primary bibliographic entry see Field 2L.
W88-11118

UNIQUE MANAGEMENT STRATEGIES FOR WASHINGTON GROUND WATER,
Washington State Dept. of Ecology, Spokane.
For primary bibliographic entry see Field 4B.
W88-11124

QUALITY ASSURANCE PROJECT PLANS - A KEY TO EFFECTIVE COOPERATIVE MONITORING PROGRAMS,
Environmental Protection Agency, Washington, DC. Quality Assurance Management Staff.
For primary bibliographic entry see Field 7A.
W88-11163

UNDERGROUND FUEL CONTAMINATION, INVESTIGATION, AND REMEDIATION: A RISK ASSESSMENT APPROACH TO HOW CLEAN IS CLEAN,
EA Engineering, Science, and Technology, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5G.
W88-11243

CONSIDERATIONS FOR OPTIMIZATION OF ABATEMENT SYSTEM DESIGN,
Groundwater Technology, Inc., Chadds Ford, PA.
W. Smith, J. Jacobson, and F. Aceto.
IN: Proceedings of the NWWA/API Conference

on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 578-587.

Descriptors: *Optimization, *Groundwater pollution, *Recovery wells, *Hydrocarbons, Wells, Case studies, Water table, Remedies, Geology, Hydrogeology, Silt, Clays, Waste recovery, Design criteria.

Over the last decade, recovery wells have been utilized for retrieval of hydrocarbons floating on the water table in varied geologic and hydrogeology conditions. Several case studies in which proper design of recovery wells to account for varying geologic conditions maximize well efficiency and contaminant recovery while minimizing groundwater removal rates. The minimization of water removal has become of particular concern in recent years due to the increase of the occurrence of recovery well installations, requirements for treatment of the pumped water prior to discharge, and concern for the removal/disposal of clean water when attempting to rehabilitate degraded aquifer conditions. Through the use of proper recovery well design, the degraded groundwater may be removed while limiting the wastage the groundwater reserves. The use of various well construction and development techniques are reviewed in cases where typical or standard well construction would have produced inefficient well production. (See also W88-11213) (Author's abstract)
W88-11245

6B. Evaluation Process

INSTITUTIONAL ARRANGEMENTS FOR GREAT LAKES MANAGEMENT: PAST PRACTICES AND FUTURE ALTERNATIVES,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 6E.
W88-10095

ESTIMATION OF MARGINAL VALUES OF WATER AS AN INSTREAM RESOURCE FOR RECREATIONAL FISHING: A NATIONAL ANALYSIS,
Iowa State Univ., Ames. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W88-10097

WATER QUALITY CLASSIFICATION OF INLAND WATERS IN FINLAND,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5A.
W88-10120

TRENDS IN IRRIGATION DEVELOPMENT, AND THEIR IMPLICATIONS FOR HYDROLOGISTS AND WATER RESOURCES ENGINEERS,
Food and Agriculture Organization of the United Nations, Rome (Italy). Land and Water Development Div.
For primary bibliographic entry see Field 3F.
W88-10486

OCEAN AND GREAT LAKES AWARENESS AMONG FIFTH AND NINTH GRADE OHIO STUDENTS: A CONTINUING STUDY,
Ohio State Univ., Columbus. School of Natural Resources.
R. W. Fortner, and V. J. Mayer.
Ohio Journal of Science OJSCA9, Vol. 88, No. 3, p 106-109, June 1988. 1 fig, 3 tab, 6 ref.

Descriptors: *Surveys, *Lakes, *Education, Knowledge, Information, Awareness, Oceans, Ohio, Great Lakes.

The Ohio Sea Grant Education Program conducted a baseline study of ocean and Great Lakes awareness among Ohio's fifth and ninth grade students in 1979 and repeated it with some curriculum-specific additions as a longitudinal study in 1983. This report of the 1983 data indicates that the ninth graders, cohort of the fifth graders, increased over 10% in ocean and Great Lakes knowledge scores over a four-year period. However, information considered critical to responsible decision-making is still lacking. Attitudes toward Lake Erie and the oceans, while remaining slightly positive for the group, did not change commensurate with knowledge. A new set of test items dealing specifically with information from Ohio Sea Grant curriculum materials was added to the survey in 1983 to provide a new baseline for future testing. The main self-reported source of student information about these topics changed over the period, so that students in both grades were relying more on the classroom than on media sources for aquatic information in 1983. The survey will be repeated at regular intervals in order to continue a longitudinal study unique to marine and aquatic education in North America. (Author's abstract)
W88-10516

EFFECT OF MASS CHEMOTHERAPY AND PIPED WATER ON NUMBERS OF SCHISTOSOMA HAEMATOBIUM AND PREVALENCE IN BULINUS GLOBOSUS IN KWALE, KENYA,
Kagoshima Univ. (Japan). Dept. of Medical Zoology.
S. Noda, M. Shimada, K. Sato, J. H. Ouma, and F. W. Thiongo.
American Journal of Tropical Medicine and Hygiene AJTHAB, Vol. 38, No. 3, p 487-495, May 1988.

Descriptors: *Chemcontrol, *Parasites, *Human pathology, *Snails, *Schistosomes, *Public health, Population exposure, Seasonal variations, Diseases, Population dynamics, Kenya, Infection, Water conveyance.

From June 1982 to May 1986 in a small village in Kwale, Kenya, the authors studied seasonal fluctuations in populations of Bulinus globosus, prevalence of Schistosoma haematobium infection in this snail, and effects of chemotherapy and piped water supply on infection rate of snails. In the perennially-flowing Pemba River, relatively small numbers of snails were collected; they were found only during the hot dry season (December to March). In a tributary stream, the Kadingo River, whose flow ceased at the end of both the cool and hot dry seasons, snail numbers peaked at the end of the cool dry season (October to November) and at the beginning of the hot dry season (January). Large numbers of infected snails were found in the Kadingo River from November to January (short rainy season and beginning of dry season). Selective mass chemotherapy, with metrifonate and provision of piped water were begun in February and March 1984. These control measures achieved a significant reduction in the infection rate of snails ($P < 0.0001$); the annual infection rate for the 2 years before treatment was 9.3% and 13.1% and for the 2 years after treatment was 3.5% and 3.4%. (Author's abstract)
W88-10840

LOOK BEFORE YOU LEAP: THE CASE FOR RESTRAINT FROM ACTIVE SITE REMEDIATION,
Environmental Resources Management, Inc., West Chester, PA.
R. P. Duchaine.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 470-486, 4 fig.

Descriptors: *Remedies, *Case histories, *Environmental management, *Groundwater pollution, *Monitoring, *Cleanup operations, Administrative regulations, Planning, Oil pollution, Environmental management.

Several case histories are presented in which site investigations have determined that active remediation of subsurface oil pollution is not an appropriate site-specific response. In each example, the regulatory agency involved, and in some cases the consultant and site owner, initially approached a case of known contamination with the assumption and expectation that active site ground water treatment would be performed. In each case, however, a site-specific program of monitoring and testing was developed to demonstrate that such efforts were not necessary despite the proximity of environmentally sensitive areas. The success of such programs indicates that cooperative approaches to site resolution, in conjunction with the establishment of a working rapport among those involved with environmental problems, can offer sound alternatives to the all-too-common and often ineffectual pump-and-treat scenario. (See also W88-11213) (Author's abstract)
W88-11241

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ESTIMATION OF MARGINAL VALUES OF WATER AS AN INSTREAM RESOURCE FOR RECREATIONAL FISHING: A NATIONAL ANALYSIS,
Iowa State Univ., Ames. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W88-10097

MAJOR CONSTRAINTS IN WATER SUPPLY IN DEVELOPING COUNTRIES,
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
T. Katko.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 231-244, 1987. 6 fig, 21 ref.

Descriptors: *Water supply development, *Developing countries, *Institutional constraints, *Cost analysis, Maintenance costs, Operating costs, Training, Management planning, Logistics, Kenya, Sri Lanka, Malawi, Tanzania.

This study shows that operation and maintenance combined with logistics (materials, spare parts, transport fuel) as well as cost-recovery are the most severe constraints in water supply in developing countries. The developing countries stress the lack of trained personnel and funding, whereas foreign experts (particularly donors) are more interested in cost-recovery. More attention should be paid to the applicability of training as well as to institutional capacity building and management issues. The lack of knowledge of water resources generally poses a more acute problem than the existence of these resources. In spite of the differences between the countries selected (Kenya, Malawi, Sri Lanka and Tanzania), there are a remarkable number of similarities. The large number of supporting agencies and projects trying to minimize the constraints seem to give rise to new ones, such as the difficult issue of coordination. (Author's abstract)
W88-10308

CALCULATING EQUITY-NEUTRAL WATER AND SEWER IMPACT FEES,
University of Southern California, Los Angeles. School of Urban and Regional Planning.
R. Peiser.
American Planning Association Journal, Vol. 54, No. 1, p 38-48, Winter 1988. 8 tab, 11 ref, 2 append.

Descriptors: *Water costs, *Economic aspects, *Costs, *Utilities, *Financing, Economies of scale, Cost analysis, Estimated costs, Urban areas, Urban planning, Marginal costs, Impact fees.

Equity-neutral impact fees should equalize the burden of paying for infrastructure facilities on all residents of a community regardless of when they move there. How this method for computing impact fees determines who bears the cost burden is demonstrated. It is concluded that impact fees, if set properly, can achieve an equity-neutral result. Equity-neutral fees are highly dependent on inflation, financing, and absorption assumptions. Economies of scale must be significant for cost

savings at capacity to outweigh the carrying costs during the period in which the excess capacity is absorbed. It may be preferable to build smaller facilities with smaller excess capacity to be absorbed. An equitable approach should include regular adjustments to accommodate differences between the initial assumptions used for setting impact fees and the actual inflation and absorption rates. (Author's abstract)
W88-10790

ARTIFICIAL RECHARGE AS A MANAGEMENT TOOL FOR HYDROLOGICALLY ISOLATED AQUIFERS,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W88-11201

ECONOMIC CONSIDERATIONS OF ATMOSPHERIC DEPOSITION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W88-11282

6D. Water Demand

ESTIMATION OF MARGINAL VALUES OF WATER AS AN INSTREAM RESOURCE FOR RECREATIONAL FISHING: A NATIONAL ANALYSIS,
Iowa State Univ., Ames. Dept. of Economics.
L. T. Hansen.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8627114. Ph.D. Dissertation, 1986. 146 p, 6 fig, 9 tab, 107 ref.

Descriptors: *Fishing, *Water resources development, *Instream use, *Instream value, *Water demand, *Streamflow forecasting, River basins, Water policy, Model studies, Stream fisheries, Regression analysis, Water use efficiency, Recreation.

The instream value of water as a fishing resource was estimated using estimates of 1980 streamflow, the availability of stream and lake sites and information on household fishing activities. Because the sample on days fishing on households is a censored one, where observations are truncated at zero, a Tobit model was used to estimate household response. The estimated responses were applied to each river basin and reduced to a measure of days fished per change in acre-foot of streamflow. Regression results indicate that stream fishing resources are an important resource in recreational fishing. The highly significant value and the stability of this coefficient across regressions containing differing combinations of the independent variables adds further evidence toward the importance of streamflow as a fishing resource. Given the social benefits obtained by use of water as a public resource, water policies should adjust their focus toward increasing streamflow and discouraging consumption. (Cremmins-AEPCO)
W88-10097

MAJOR CONSTRAINTS IN WATER SUPPLY IN DEVELOPING COUNTRIES,
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6C.
W88-10308

PRESENT AND FUTURE PERSPECTIVES ON WATER RESOURCES IN DEVELOPED COUNTRIES,
Politecnico di Milano (Italy). Inst. of Hydraulics.
U. Maione.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 1, p 87-102, February 1988. 3 fig, 5 tab, 17 ref.

Descriptors: *Research, *Water resources development, *Developing countries, *Developed countries, *Decision making, *Water use, *Hydrology, *Geohydrology, *Water quality, *Flood control, Data interpretation, Comparison studies, Urban areas, Management planning, Floods.

Based on some present and past features of water resources in developed countries, some future trends towards the development of water sciences are outlined. Data are presented to show differences in water use between developed and developing countries and water consumption in urbanized areas of several developed countries is shown. The reduction of specific consumption use, the amelioration of water quality, and the improvement of flood control measures should dictate innovations in water resources technology. Decision analysis will also play a larger role in water resources analysis and pianning than at present. These trends should also introduce new perspectives in the development of hydrological sciences, so indicating ways to overcome the present crisis. (Author's abstract)
W88-10488

PRESENT AND FUTURE PERSPECTIVES OF WATER RESOURCES IN DEVELOPED COUNTRIES,
Politecnico di Milano (Italy). Inst. of Hydraulics.
U. Maione.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 101-115, 1988. 3 fig, 5 tab, 36 ref.

Descriptors: *Water management, *Resources management, *Water demand, *Research priorities, *Water resources development, *Management planning, Design standards, Design criteria, Water quality, Water quality control, Planning, Hydrology, Flood control.

Based on some present and past features of water resources in developed countries, some future trends are outlined towards the development of water sciences. The reduction of specific consumption use, the amelioration of water quality, and the improvement of flood control measures should dictate innovation of water resources technology. Decision analysis should play a larger role in water resources analysis and planning than it does at present. These trends will also introduce new perspectives in the development of hydrological sciences, so indicating a route to overcome the present crisis. (Author's abstract)
W88-10762

PREDICTING FUTURE GROUND WATER LEVELS WITH CONFIDENCE,
Brown and Caldwell, Atlanta, GA.
For primary bibliographic entry see Field 4B.
W88-10962

MANAGEMENT OF WATER USE IN SOUTH FLORIDA -- PROBLEMS AND SOLUTIONS,
South Florida Water Management District, West Palm Beach.
For primary bibliographic entry see Field 4B.
W88-11097

GROUND WATER MANAGEMENT UNDER THE APPROPRIATION DOCTRINE,
Idaho Univ., Moscow. Water Resources Research Inst.
For primary bibliographic entry see Field 4B.
W88-11122

SOUTHEASTERN ALASKA HATCHERY INNOVATIVE GROUND WATER SYSTEM,
Sweet, Edwards and Associates, Inc., Kelso, WA.
For primary bibliographic entry see Field 2F.
W88-11130

1986 ANNUAL REPORT FROM THE WATER BUDGET MANAGERS,
Fish Passage Center, Portland, OR.
M. Karr, and M. DeHart.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-009917. Price codes: A04 in paper copy, A01 in microfiche. DOE Report No. DOE/BP/11639--3, (1987). 84 p, 14 fig, 10 tab, 3 append. DOE Contract DE-AI79-84BP15465 and DE-AI79-83BP11639. Project Nos. 83-536 and 83-491.

Descriptors: *Hydrologic budget, *Water management, *Monitoring, Flow characteristics, Water use, Smolt, Fish management, Rivers, Columbia River, Washington, Oregon, Data interpretation, Fish passages.

1986 was the fourth year of operation of the Fish Passage Center (formerly Water Budget Center, Columbia River Basin) under the guidance and supervision of the fishery agencies and tribal Water Budget Managers, and the third year of formal water budget implementation. The first year, 1983, was considered a trial year because the water budget had not yet been incorporated as a firm constraint into the regional coordinated plan of operation for power production. In addition to management of the Water Budget, the Water Budget Managers and FPC staff developed and directed the Smolt Monitoring and Water Budget Evaluation Programs of Section 304(d) of the Fish and Wildlife Program. The fishery agencies and tribes also authorized the Water Budget Managers to coordinate agency and tribal system operational requests throughout the year, including spill management for fish passage. This report summarizes Water Budget Manager activities in implementing program measures, including 1986 flow conditions, water budget usage and spill management, and the in-season management portion of the 1986 Smolt Monitoring Program including data management. (Lantz-PTI)
W88-11272

6E. Water Law and Institutions

SOIL CONSERVATION: POLITICS, POLICY AND PLANNING,
Pennsylvania Univ., Philadelphia. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 2J.
W88-10093

INSTITUTIONAL ARRANGEMENTS FOR GREAT LAKES MANAGEMENT: PAST PRACTICES AND FUTURE ALTERNATIVES,
Michigan Univ., Ann Arbor.
M. J. Donahue.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8702720. Ph.D. Dissertation, 1986. 551 p, 9 fig, 23 tab, 133 ref, append.

Descriptors: *International waters, *Ecosystems, *River basin development, *Water resources development, Comprehensive planning, Literature review, Surveys, Institutions, Organizations.

Institutional arrangements for regional resource management in the Great Lakes Basin were analyzed with the five objectives of (1) providing a historical perspective on the form and evolution of institutional arrangements for regional resource management and on the range of approaches used by the United States and Canada; (2) identifying organizational characteristics and management strategies; (3) exploring the linkages between the components of the Great Lakes institutional ecosystem and identifying means for strengthening them; (4) developing guidelines, parameters, and organizational criteria that might be considered to be essential components for a viable institution or set of institutions; and (5) designing alternative institutional arrangements to encourage the orderly and informed evolution of the Great Lakes institutional ecosystem. Information sources were the theoretical and applied literature, personal interviews, a questionnaire survey, and observation and analysis of relevant institutions. (Cremmins-AEPCO)
W88-10095

ORGANIZATIONAL ALTERNATIVES FOR EXTERNAL SUPPORT IN WATER SUPPLY,
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
T. Katko.

Aqua Fennica AQFEDI, Vol. 17, No. 1, p 3-15, 1987. 2 fig, 1 tab, 29 ref.

Descriptors: *Water treatment, *Administrative agencies, *Ogranizations, *Economic aspects, *Municipal water, Water quality control, Cost allocation, Potable water, Drinking water, Organizations, Long-term planning, Future planning, Public policy, Water policy.

For quite a while there has been debate about the most appropriate organizations through which the support for drinking water supply and sanitation should be directed. This paper looks at the trends in external funding and describes the various organizational and institutional alternatives for channeling the support. The study is based on a literature survey, field work experiences and informal discussions and interviews mainly with East African and Finnish water sector professionals. External support agencies typically allocate two to four percent of their total assistance to the water supply and sanitation sector. The present Water Decade has hardly managed to attract additional funding. Low-cost technology, cost-recovery and organizations must be developed further. Coordination is imperative because of the great number of supporting agencies. Individual experts, expert teams and volunteers need adequate supporting services. Distinct or autonomous project management units are particularly needed in large projects with advanced technology. At the local level grass-root organizations can help in channeling support and maintaining programs. The private sector can contribute by joint ventures, consumers' associations and institutionalized vending. Different forms of assistance need not be competitive but can support each other. (Author's abstract)
W88-10112

NEW IDEAS ON POLLUTION CONTROL IN THE PULP AND PAPER INDUSTRY--ARE THERE ANY,
Confederation of Finnish Industries, Helsinki.
For primary bibliographic entry see Field 5G.
W88-10331

REGIONAL INITIATIVES IN WATER QUALITY MANAGEMENT: THE EXPERIENCE OF THE FORMER NEW ENGLAND RIVER BASINS COMMISSION,
New England Governors' Conference, Inc., Boston, MA.
C. J. Fausold.
The Environmental Professional, Vol 10, No. 1, p 80-83, 1988.

Descriptors: *Institutions, *Regional planning, *Water quality management, *River basins, *New England, *Water resource institutes, Planning, Management, Interagency cooperation, Administrative agencies, Water quality control, Water pollution control, Groundwater management, History.

The experiences of the former New England River Basins Commission (NERBC) are discussed as an example of a regional initiative in water quality management. Although there were earlier cooperative efforts to address specific issues such as flooding or hydropower, the first comprehensive study of New England's water resources was undertaken by the New England-New York Interagency Committee (NENYIAC) during the period 1950 to 1955. The next stage in New England's water resource management history came with the establishment of the Northeastern Resources Committee (NRC) in 1956. The demise of the NRC came in 1965 with the implementation of the Water Resources Planning Act of 1965, which established a program of matching grants to the states for water resources planning purposes and created the U.S. Water Resources Council for coordinating water planning activities at the federal level. The Act also authorized the establishment of joint, state/federal river basin commissions, known as Title II commissions. New England's was established in 1967 and was called the New England River Basins Commission (NERBC). When the NERBC was terminated in 1981, three advisory committees were established by the region's governors to carry on certain functions of NERBC. Among the advantages of this most recent arrangement is the fact that a small, not-for-profit institution avoids the inefficiencies inherent in any large government bureaucracy. (Friedmann-PTT)
W88-10633

TAMING THE WILD MISSOURI RIVER: WHAT HAS IT COST,
Nebraska Game and Parks Commission, Norfolk.
L. W. Hesse.
Fisheries, Vol. 12, No. 2, p 2-9, March-April 1987. 2 fig, 1 tab, 24 ref.

Descriptors: *River regulation, *Public policy, *Water resources development, *Missouri River, *Fisheries, Legislation, Cost analysis, Channeling, Reservoirs.

The most significant legislation that authorized the alteration of the Missouri River is reviewed from a fisheries position. An outline of the dollar costs to achieve change along the river shore shows the U.S. taxpayer has spent more than $6 billion in the Missouri River Basin. Broad ecological concern about lost riverine resources is raised. Mitigation, management, or enhancement of riverine resources has not been successfully completed. Alternatives to impoundment and channelization were not adequately discussed, and the extent of environmental damage was unknown, unexpected, and unstudied at the time these projects were planned. There was sufficient latitude in congressional action after 1944 to have provided some safeguard, had these laws been interpreted with a concern for wildlife. (Author's abstract)
W88-10797

OPPORTUNITY FOR INTEGRATED MANAGEMENT OF THE FLATHEAD RIVER-LAKE ECOSYSTEM, MONTANA,
Northwest Power Planning Council, Portland, OR.
For primary bibliographic entry see Field 5G.
W88-10898

GROUND WATER HYDROLOGY AND WATER LAW: BRIDGING THE GAP WITH MODELS,
For primary bibliographic entry see Field 4B.
W88-10924

AQUATIC TOXICOLOGY AND HAZARD ASSESSMENT: EIGHTH SYMPOSIUM.
For primary bibliographic entry see Field 5C.
W88-10991

SCIENTIFIC CONSIDERATIONS IN THE LEGISLATIVE ARENA,
House, Washington, DC.
R. Durbin.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 7-14.

Descriptors: *Information exchange, *Legislation, *Decision making, *Toxicology, *Management planning, Aquatic toxicology, Regulations, Standards, Legal aspects.

Nearly all members of Congress are less than expert in scientific areas. In forming a position on a scientific issue, a member of Congress can rely on information supplied through one of Congress' in-house agencies, such as the Office of Technology Assessment, which can generate papers on different scientific areas as well as provide an idea of the most promising areas within a particular field. Information can also be obtained from the Congressional Research Service, which provides studies in almost any area imaginable. There is also the information provided by the staff of different committees, as well as that supplied by members' personal staffs. Decisions based on scientific information can fall into a number of different areas, such as energy, the environment, health issues, or budget issues. Congress makes use of scientific information in performing its oversight role. Once the Congress passes a law, such as the Federal Insecticide, Fungicide and Rotenticide Act (FIFRA), or the Toxic Substances Control Act (TSCA), it is then up to the administrative agencies to implement the law by establishing regulations and standards that must be complied with (EPA, FDA, OSHA, and the Consumer Produce Safety Commission). The Oversight Subcommittees of different House Committees have the authority to oversee the implementation of these laws to see whether they are meeting the goals the Congress set out for them. (See also W88-10991) (Lantz-PTT)
W88-10992

SCIENTIFIC CONSIDERATIONS IN THE INTERNATIONAL ARENA,
Unilever Research Port Sunlight Lab. (England).
C. M. Lee.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 15-26, 5 fig, 1 tab, 13 ref.

Descriptors: *International law, *Information exchange, *Management planning, *International commissions, *Toxicology, Aquatic toxicology, Standards, Hazard assessment.

The last decade has seen the introduction of significant pieces of national legislation to control the use of chemicals and ensure their human and environmental safety. In the last five years the Organization for Economic Cooperation and Development (OECD) Program on Chemicals has achieved significant international harmonization of the principles and many of the methods for assessing the potential hazard of chemicals to man and the environment. The mutual acceptance of data between nations using these harmonized methods has also been agreed and will contribute to the avoidance of nontariff barriers to trade and the unnecessary duplication of effort. Despite these achievements, however, the scientific and legislative communities have yet to learn how to communicate fully and effectively. The development of standard methods remains too slow, and too little attention is paid to the validation of methods, which is hindering the international harmonization process. Considerable scope remains for the improvement of the mechanism by which international harmonization is achieved. This should include establishing closer links between the standardization organizations and those developing legislation and deriving an approach that will avoid the premature introduction of research results. (See also W88-10991) (Author's abstract)
W88-10993

CLEAN WATER ACT UPDATE: A NEW ROLE FOR TOXICOLOGY,
Environmental Protection Agency, Washington, DC. Office of Analysis and Evaluation.
For primary bibliographic entry see Field 5G.
W88-10994

WATER QUALITY CRITERIA: PROTECTION OF USE PERSPECTIVE,
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
For primary bibliographic entry see Field 5G.
W88-10996

NEW APPROACH FOR REGULATING IRON IN WATER QUALITY STANDARDS,
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
For primary bibliographic entry see Field 5G.
W88-11003

COORDINATION OF LOCAL, STATE, AND FEDERAL AGENCIES' RESPONSE TO

GROUNDWATER CONTAMINATION EPISODES,
Elkhart County Health Dept., IN. Environmental Health Div.
R. T. Brown, M. D. Michael, and M. A. Furfaro.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 3-17, 5 append.

Descriptors: *Groundwater management, *Interagency cooperation, *Groundwater pollution, Indiana, Drinking water, Wells, State jurisdiction, Federal jurisdiction, Public relations, Case studies.

To date in Elkhart County, Indiana, thirty-three cases of groundwater contamination involving volatile organic compounds have been discovered. Hundreds of residential wells, as well as a municipal well field, have been affected. Millions of dollars in state and federal assistance have ensured that affected residents have been supplied with safe drinking water. The coordination of local, state, and federal agencies' responses to the discovery of a groundwater contamination episode is fundamental to arriving at a timely, efficient, and enduring solution. What triggers involvement of state and federal agencies, what activities are best performed by local officials rather than state or federal authorities, and when it is best to release information to the media are questions addressed in this paper. The County Road One groundwater contamination case in Elkhart County presents an excellent example of local, state, and federal officials working together to determine the extent of the groundwater contamination, to inform affected residents, to provide safe drinking water, and to identify the responsible parties. Distinct roles were played by each of the agencies involved and the strengths and weaknesses of each level of government when dealing with groundwater contamination were revealed. (See also W88-11031) (Author's abstract)
W88-11032

INDIANA CODE 13-2-2.5: WATER RIGHTS IN INDIANA,
Indiana State Dept. of Natural Resources, Indianapolis.
For primary bibliographic entry see Field 4B.
W88-11039

TECHNICAL AND PROCEDURAL CONSIDERATIONS FOR IMPLEMENTING AN UNDERGROUND TANK ABANDONMENT PROGRAM,
RMT, Inc., Madison, WI.
For primary bibliographic entry see Field 5G.
W88-11086

NEW APPROACH TO PROTECTION OF SENSITIVE AQUIFERS IN FLORIDA,
Florida State Dept. of Environmental Regulation, Tallahassee.
For primary bibliographic entry see Field 5G.
W88-11090

MANAGEMENT OF WATER USE IN SOUTH FLORIDA -- PROBLEMS AND SOLUTIONS,
South Florida Water Management District, West Palm Beach.
For primary bibliographic entry see Field 4B.
W88-11097

GROUND WATER MANAGEMENT UNDER THE APPROPRIATION DOCTRINE,
Idaho Univ., Moscow. Water Resources Research Inst.
For primary bibliographic entry see Field 4B.
W88-11122

UNIQUE MANAGEMENT STRATEGIES FOR WASHINGTON GROUND WATER,
Washington State Dept. of Ecology, Spokane.
For primary bibliographic entry see Field 4B.
W88-11124

LEAKING UNDERGROUND STORAGE TANKS: WHAT IS REQUIRED; WHAT IS REALISTIC,
IT Corp., Houston, TX.
For primary bibliographic entry see Field 5G.
W88-11206

INDUSTRY'S RESPONSE TO L.U.S.T. REGULATIONS IN FLORIDA AND RECOMMENDATIONS FOR APPLICATION OF AVAILABLE TECHNOLOGIES,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W88-11207

UNDERGROUND FUEL STORAGE SECONDARY CONTAINMENT: THE SOUTH FLORIDA EXPERIENCE,
Seaman Corp., Millersburg, OH.
For primary bibliographic entry see Field 5G.
W88-11208

TRENDS IN GROUND WATER LAW IN THE CAROLINAS AND VIRGINIA: 1985,
North Carolina Univ. at Chapel Hill. Inst. of Government.
M. S. Heath.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 380-400, 55 ref.

Descriptors: *North Carolina, *South Carolina, *Virginia, *Groundwater quality, *Water law, *Water rights, *Legislation, *Well regulations, Ordinances, Florida, Common law, Groundwater pollution, Contamination, Legal aspects.

Groundwater law in the southern states is typically a mixture of common law precedents concerning water rights; statutes that set public policy concerning matters such as well construction standards, well driller registration, and groundwater contamination; administrative regulations that implement these statutes in greater detail; and local ordinances that supplement the state laws with respect to localized conditions. Federal legal developments are beginning to have an impact on the body of groundwater law in the southern states and elsewhere, especially covering water quality issues. With continuing heavy reliance on groundwater for domestic and other supplies, and with growing concern about groundwater contamination (and competition for supplies is some areas), pressure for change in groundwater law has been growing in the south. Legal developments along these lines in the Carolinas and Virginia are reviewed with emphasis on North Carolina. Some of the notable trends of recent years include (1) the development of common law doctrines concerning the right to use groundwater in North Carolina and Virginia; (2) the erosion of simple ownership concepts in the wake of growing public interest borne of development pressures; (3) the development of some independent legislative and program initiatives by these states, including capacity use areas laws in all 3 states, and the beginnings of a groundwater quality classification system and enactment of a well construction standards law in North Carolina; (4) the adoption of well ordinances by some localities; and (5) the growing impact of federal law on groundwater quality issues through legislation such as RCRA, Superfund, and the Safe Drinking Water Act, and concrete application of these statutes in court decisions. (See also W88-11182) (Author's abstract)
W88-11209

EFFECTS OF DEPLETION OF THE OGALLALA AQUIFER AND ACCOMPANYING IMPACT ON ECONOMIC AND AGRICULTURAL PRODUCTION IN THE SOUTHERN HIGH PLAINS REGION OF THE UNITED STATES,
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 6G.
W88-11211

'REALISTIC' COST ESTIMATES FOR ALTERNATIVE REMEDIAL ACTIONS OF CONTAMINATED, UNSATURATED SOILS AND UNDERLYING AQUIFERS,
Canonie Environmental Services Corp., San Mateo, CA.
L. D. Gaselbracht, T. A. Donovan, and R. J. Greenwood.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 565-577, 4 ref.

Descriptors: *Estimated costs, *Hazardous wastes, *Economic aspects, *Long-term planning, *Cleanup operations, *Groundwater pollution, *Soil contamination, Aeration zone, Aquifer management, Remedies, Solid waste, Liquid waste, Waste treatment, Hazardous materials, Landfills, Water quality control, Feasibility studies, Management planning, Ozonation, Biodegradation, On-site wastewater treatment.

In the last several years, it has become extremely expensive to implement the types of remedial actions considered the most feasible. Liquid hazardous wastes can no longer be placed in a pond for evaporation. Liquid waste must be either treated with available technology or solidified for disposal as solid waste. Personnel at manufacturing or industrial sites need to know what alternative methods of remediation are available to them and what are the approximate costs for implementation. The cost of implementing a remedial plan is usually the factor used to determine if the proposed remedial plan is usually the factor used to determine if the proposed remedial plan is a viable course of action. Alternative remediation methods are described for soils aeration/volatilization (McKin process, Taciuls process, on-site containment, soil fixation), plume control (extraction trenches, slurry walls), and groundwater treatment (biodegradation, ozonation with UV destruct). The alternative remedial methods discussed have either been implemented by the authors in the course of their consulting engineering and construction work, or are in the pilot-scale stage awaiting full-scale implementation. (See also W88-11213) (Author's abstract)
W88-11244

QUALITY CRITERIA FOR WATER 1986.
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W88-11267

6G. Ecologic Impact Of Water Development

GEOGRAPHICAL, SEASONAL AND ECOLOGICAL DISTRIBUTION OF MOSQUITO LARVAE (DIPTERA CULICIDAE) IN SOUTHERN ISRAEL,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Biology.
J. Margalit, C. Dimentman, and A. S. Tahori.
Archiv fuer Hydrobiologie AHYBA4, Vol. 112, No. 2, p 233-249, April 1988. 2 fig, 6 tab, 12 ref.

Descriptors: *Public health, *Mosquitos, *Israel, Aquatic insects, Ecology, Population dynamics, Ecosystems, Data acquistion, Seasonal variation, Aquatic environments, Israel, Spatial distribution, Seasonal distribution, Ecological distribution, Larvae.

Mosquitos are potential vectors of important diseases of man and domestic animals in the Middle East. Israel and its neighboring countries have suffered severely from malaria. Recently, Rift Valley virus spread from Sudan to Egypt. Thus the danger of its entering Israel has become acute. Species composition, as well as geographical, ecological and seasonal distribution patterns of mosquito larvae from 95 water bodies in southern Israel were investigated. Natural aquatic habitats in southern Israel consist of permanent scattered

springs and streams and temporary rock pools. In addition, new artificial aquatic habitats have been formed as a result of expansion in rural and urgan development; these new types of water bodies inlcude artificial lakes, oxidation ponds and sewage-polluted streams near new settlements, and certain swamp areas formed by water pipe seepage in rural areas. Maximal numbers of larvae and of larvae per sample were collected during the months of May and July and minimal numbers during January. Twenty species of Culicidae larvae were identified. The largest number of species was found during autumn. Six species occurred almost the year round. The most common species collected in relation to the number of breeding sites was Culex pipiens. Data are presented on the association pattern of the various species. The chemical characteristics of the breeding habitats are described. Distribution patterns of the mosquito larvae confirm the existence of an ecological barrier that prevents colonization of southern Israel by about half of the Culicidae species found in the more humid regions of Israel. (Author's abstract)
W88-10130

POTENTIAL IMPACT OF LARGE-SCALE TIDAL POWER DEVELOPMENTS IN THE UPPER BAY OF FUNDY ON FISHERIES RESOURCES OF THE NORTHWEST ATLANTIC,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
M. J. Dadswell, R. A. Rulifson, and G. R. Daborn.
Fisheries, Vol. 11, No. 4, p 26-35, July/August 1986. 8 fig, 6 tab, 37 ref.

Descriptors: *Tidal effects, *Dam effects, *Estuaries, *Fish migration, *Tidal hydraulics, *Atlantic ocean, *Hydroelectric plants, *Bay of Fundy, Atlantic Ocean, Fish passages, Salt marshes, Sedimentation, Turbine mortality, Design criteria, Mud flats, Estuaries, Fish, Tides, Tidal marshes, Tidal flats.

Construction of large-scale hydroelectric tidal power developments in the upper Bay of Fundy is receiving serious consideration. Potential designs involve ebb-generation with 1400-5300 MW plants using 7.6 m diameter, straight-flow, low-head turbines installed in dams up to 8 km in length. Discharge through individual turbines will be 400 cu m per sec at 50 revolutions per minute with draft velocities of 11.4 m per sec. Calculated parameters for these turbines are a water length of 2.26 m, impact velocity of 23.99 m per sec, blade tip velocity up to 28.7 m per sec and a total pressure flux of 1.7 atm. The existing environment is macrotidal (tide range 11-16 m). Embayments are homogeneous estuaries with extremely turbid water. The intertidal biological community is a salt marsh-mudflat biome. The pelagic zone supports large populations of migratory fishes, particularly the alosids, Alosa sapidissima, A. aestivalis, A. pseudoharengus, and Clupea harengus. Striped bass, spiny dogfish, Atlantic salmon, and Atlantic sturgeon also constitute a significant portion of the fish community. Tagging experiments indicate this region is a northern migration terminus for American shad populations from all Atlantic coast rivers; abundance in an individual tidal basin is about 1.5 million adults during a single tidal cycle. Striped bass and alewife tagged in this region have been taken as far south as North Carolina. Upstream tidal headponds will have reduced tide ranges of 5-6 m and the lower energy will result in stratification of the water column and less turbidity. Increased sedimentation above and below the dams is expected to affect local shell clam fisheries. Tidal barrages may alter fish migration routes and repeated passage through turbines during tide-related movements will cause significant mortality to both fish and marine mammals. Existing knowledge for fish passage design in this environment is inadequate for development of sound migration measures. (Author's abstract)
W88-10283

FISH COMMUNITIES OF THE UPPER DANUBE RIVER (GERMANY, AUSTRIA) PRIOR TO THE NEW RHEIN-MAIN-DONAU CONNECTION,
Guelph Univ. (Ontario). Dept. of Zoology.
E. K. Balon, S. S. Crawford, and A. Lelek.
Environmental Biology of Fishes EBFID3, Vol. 14, No. 4, p 243-271, April 1986. 9 fig, 10 tab, 89 ref.

Descriptors: *Exotic species, *Fish migration, *Baseline studies, *Danube River, *Rivers, *Fish populations, *Canals, Species composition, Black Sea, North Sea system, Engineering effects, Fish, Eel, Lamprey, Austria, Germany, Factor analysis, River zones.

A study of fish communities in the upper Danube was carried out at 19 locations in 1976 and 1984, yielding 24 samples with over 23,000 specimens. Forty-two species - 8 of them new for this part of the Danube - and 6 cyprinid hybrids were identified. Two distinct regions, above and below Ulm, were recognized for the upper Danube on the basis of both abiotic (distance from source, elevation, river gradient) and biotic (species richness, species distribution) characteristics of the localities. Nine species were distributed over most of the upper Danube, while 10 and 23 species were limited mostly to the upriver and downriver sections, respectively. A factor analysis of ecomorphological attributes for 28 dominant species revealed a generalist-specialist pattern among their swimming behavior and feeding modes. The proportion of swimming and feeding specialists differed significantly between the upriver and downriver communities. Potential species for invasion into the North Sea system, when the Rhein-Main-Donau canal opens, were identified, and the danger of a reverse invasion by both sea lamprey and eel into the Black Sea system was explained. Although experience with other large ship canals (Erie, Welland and Suez) seems to indicate that serious changes may be delayed for about half a century, these changes are predicted and warned against. (Author's abstract)
W88-10284

EFFECT OF THE GOCZALKOWICE DAM RESERVOIR ON THE HYDROCHEMICAL CONDITIONS OF THE RIVER VISTULA BELOW THE DAM (SOUTHERN POLAND),
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 5B.
W88-10366

EFFECT OF THE GOCZALKOWICE DAM RESERVOIR ON ZOOBENTHOS OF THE RIVER VISTULA (SOUTHERN POLAND),
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 5C.
W88-10372

FAUNISTIC STUDY OF CHIRONOMIDS (DIPTERA) OF THE UPPER NESTE D'AURE (CENTRAL PYRENEES): THE IMPACT OF HYDROELECTRIC SCHEMES (ETUDE FAUNISTIQUE DES CHIRONOMIDES (DIPTERA) DE LA HAUTE NESTE D'AURE (PYRENEES CENTRALES): IMPACT DES AMENAGEMENTS HYDROELECTRIQUES),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
G. Gazagnes, and H. Laville.
Annales de Limnologie ANLIB3, Vol. 21, No. 2, p 149-159, 1985. 3 fig, 5 tab, 27 ref.

Descriptors: *Mountain streams, *Ecology, *Aquatic habitats, *Midges, *Dam effects, *Instream flow, *Population dynamics, *Ecosystems, Animal populations, France, Pyrenees, Comparison studies, Neste d'Aure River, Esaragne River, Hydroelectric plants.

This is a study of the chironomids of the hydrographical system of the Neste d'Aure, a Pyrenean river at mean altitude (1000 to 1500 m). Drift samples taken at eight stations in summer (August and September 1980) and winter (February 1981) were used to characterize the population of the river at mean altitude and were compared with the population in Estaragne, a river in the same system but at higher altitude (2370-1850 m). Comparison of populations upstream and downstream of three reservoirs showed the importance of flow reserves for maintaining the downstream ecosystem. (Author's abstract)
W88-10466

OBSERVATIONS ON THE MIGRATION BEHAVIOR OF ALEWIFE (ALOSA ALOSA L.) IN THE ARTIFICIAL CANAL OF GOLFECH HYDROELECTRIC PLANT (OBSERVATIONS SUR LE COMPORTEMENT MIGRATOIRE DES ALOSES (ALOSA ALOSA L.) DANS LE CANAL ARTIFICIEL DE L'USINE DE GOLFECH),
Ecole Nationale Superieure Agronomique de Toulouse (France). Lab. d'Ichthyologie Appliquee.
A. Belaud, R. Dautrey, R. Labat, J. P. Lartigue, and P. Lim.
Annales de Limnologie ANLIB3, Vol. 21, No. 2, p 161-172, 1985. 4 fig, 3 tab, 17 ref.

Descriptors: *Fish populations, *Fish migration, *Temperature effects, *Canals, Marking techniques, Garonne River, Aquatic habitats, France, Water temperature, Hydraulics, Hydroelectric plants.

For 4 consecutive years, daily fishing over the period of upstream migration of alewives (Alosa alosa L.) were performed on the site of Golfech, a hydroelectric plant on the Garonne River. This paper presents observations on the migratory behavior of this fish in the artificial canal located between the plant and the confluence. The migration develops in spring when the water temperature reaches approximately 16 C and, above this level, the maximal affluence of alewives corresponds with increasing temperature phases. The relationships between water temperature and capture abundance is significant if one considers the beginning of the migration, then becomes inconsistent when the migration reaches the maximum. Similar to the thermal factor, there are hydraulic characteristics that influence the alewive migration (water flow through the different turbines, downstream level). The evaluation of the fish stock, using marking techniques, is not satisfactory because of the small number of fish recaptured. Analysis of daily fishing data demonstrates that there is no accumulation of alewives day after day, in front of the factory. The various fishing operations indicate that alewives explore diurnally upward and downward in the artificial canal by passing on the bottom. Every night or when the conditions are unfavorable they stay in deep water downstream in the river. Compared with previous observations, the actual results indicate a typical migratory behavior in an artificial canal. (Author's abstract)
W88-10467

SIMULIIDAE (DIPTERA: NEMATOCERA) OF THE NESTE D'AURE (CENTRAL PYRENEES) I. THE IMPACT OF HYDROELECTRIC SCHEMES IN THE UPPER VALLEY (LES SIMULIIDAE (DIPTERA: NEMATOCERA) DE LA NESTE D'AURE (PYRENEES CENTRALES). I. IMPACT DES AMENAGEMENTS HYRODELECTRIQUE DANS LA HAUTE),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
M. Clergue-Gazeau, and G. Gazagnes.
Annales de Limnologie ANLIB3, Vol. 22, No. 2, p 195-203, 1986. 1 fig, 4 tab, 21 ref.

Descriptors: *Population density, *Aquatic insects, *Water pollution effects, *Temperature effects, *Thermal pollution, *Dam effects, *Instream flow, On-site data collections, Data analysis, Drift samples, Reservoirs, Hydroelectric plants, Sampling, Aquatic populations, Aquatic drift, France, Insects.

The Simuliidae collected in water and summer drift samples in the Neste d' Aure (altitude 1100 to 1600 m), a regulated stream in the central Pyrenees (France) are Tabulated. The population distribution was analyzed using data from eight drift stations chosen upstream and downstream of three reservoirs. The analyses shows a constant reduction in the number of nymphae and larvae in the samples from August through February. In stations 1 and 2 (altitude 1400 m), the percent of Simuliidae

among the Dipterae were 8% in August, 15% in September, and practically none in February. In stations 3, 4, and 5 (all at 1360 m) the insect numbers were negligible and at station 6 (1200 m) the Simuliidae were 64% in August, 44% in September and 15% in February of the total Dipterae population. The Chironomidae were dominant. This was also true for station 8 (1080 m; reserve flow downstream of the dam, where in August Simuliidae were 81% of the total Diptera population whereas toward February, the Chironomidae were in overwhelming numbers among the Diptera. The existence of the reserve flow provides conditions which result in maintaining the dominance of the Simuliidae in this reach of the stream. (Friedmann-PTT)
W88-10478

EFFECT OF IMPOUNDMENTS ON THE QUALITY OF WATER AND BIOCOENOSIS IN THE LOWLAND STREAMS RAWKA AND SKIERNIEWKA - SUMMER ASPECT,
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W88-10607

STUDY OF SOME PHYSIOCHEMICAL PROPERTIES OF NILWALA RIVER WATERS IN SOUTHERN SRI LANKA WITH SPECIAL REFERENCE TO EFFLUENTS RESULTING FROM ANTHROPOGENIC ACTIVITIES,
Ruhuna Univ., Matara (Sri Lanka). Dept. of Botany.
For primary bibliographic entry see Field 4C.
W88-10641

INFLUENCE OF HABITAT STRUCTURE ON THE FISH ASSEMBLAGES ASSOCIATED WITH TWO COOLING-WATER INTAKE STRUCTURES IN SOUTHERN CALIFORNIA,
Occidental Coll., Los Angeles, CA. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W88-10749

CHANGES IN THE UNDER-ICE CHARACTERISTICS OF LA GRANDE RIVIERE PLUME DUE TO DISCHARGE VARIATIONS,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 5B.
W88-10776

TAMING THE WILD MISSOURI RIVER: WHAT HAS IT COST,
Nebraska Game and Parks Commission, Norfolk.
For primary bibliographic entry see Field 6E.
W88-10797

IMPLICATIONS IN RECREATION ON RESERVOIRS,
Vyzkumny Ustav Vodohspodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2H.
W88-10807

MERCURY PROBLEM IN RECENTLY FORMED RESERVOIRS OF NORTHERN MANITOBA (CANADA): EFFECTS OF IMPOUNDMENT AND OTHER FACTORS ON THE PRODUCTION OF METHYL MERCURY BY MICROORGANISMS IN SEDIMENT,
National Hydrology Research Inst., Saskatoon (Saskatchewan).
T. A. Jackson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 45, No. 1, p 97-121, January 1988. 13 fig, 19 tab, 57 ref.

Descriptors: *Reservoirs, *Methylmercury, *Mercury, *Water pollution sources, Microorganisms, Organic matter, Nutrients, Heavy metals, Inorganic compounds, Clay, Silt, Water pollution, Erosion, Aerobic conditions, Floods, Deposition, Manitoba, Canada, Hydroelectric plants.

Creation of hydroelectric reservoirs by enlargement of riverine lakes and flooding of adjacent forested land along the Churchill River diversion route has led to a marked rise in rates of methyl mercury production by microorganisms in sediments. This phenomenon has resulted primarily from stimulation of microbial activity by organic matter in submerged land areas and is due both to utilization of organic nutrients by methylators and to concomitant oxygen depletion. Release of mercury from scattered low-level sources in this organic matter is a secondary contributing factor. Compared with submerge terrestrial organics, organic matter from aquatic biota has only been of minor importance in promoting methyl mercury production. In some regions, clay and silt eroded from shoreline deposits have inhibited methyl mercury production appreciably. The aerobic conditions prevailing in well-flushed mainstream regions tend to increase the 'availability' of sediment-bound inorganic mercury for methylation while decreasing the rate at which microbes are able to methylate the mercury; under less aerobic conditions in quiet backwater regions, the reverse is true. (Author's abstract)
W88-10823

BREACHING THE MOUTH OF THE BOT RIVER ESTUARY, SOUTH AFRICA: IMPACT ON ITS BENTHIC MACROFAUNAL COMMUNITIES,
Cape Town Univ. (South Africa). Dept. of Zoology.
H. P. De Decker.
Transactions of the Royal Society of South Africa, Vol. 46, Part 3, p 231-250, June 1987. 10 fig, 1 tab, 28 ref.

Descriptors: *Bot River Estuary, *Estuaries, *Ecology, *Benthic fauna, *Biomass, *Population dynamics, Saline water, Macrophytes, Hydraulic engineering, Limnology, Population exposure, Biomass, South Africa, Macroinvertebrates, Cycling nutrients, Species diversity.

The changes occurring in the benthic macrofaunal communities of the Bot River estuary, after an artificial opening of its mouth on 29 June 1983, are presented and the possible short- and long-term effects of this disturbance on their ecology are described. Surveys of the benthos conducted in December 1982 and May 1983, before the mouth-breaching, are compared with similar surveys afterwards: in Oct. 1983, a week prior ot reclosure of the estuary, and three months later, in Jan. 1984. The total number of species decreased from 23 in May to 15 in October; however, only those species that contributed less than 5% to the total biomass in May were lost. The largest reduction in species abundance and biomass were related to the collapse of the macrophyte, Ruppia maritima, which is intolerant of high salinities. The species that were reduced most were Arcuatula capensis, Melita zeylanica and Cyathura estuaria. These species were adversely affected by the loss of their attachment substrate (Arcuatula capensis), and possibly increased predation pressure due to the reduction in macrophytic cover. In the areas not colonized by Ruppia, the dominant species exhibited an increase while the mouth was open, and that transported nutrients from the decaying macrophytes in the shallows to communities in the deeper waters. This assumption is strengthened by the fact that densities in the deeper areas returned to their usual low levels once closure of the mouth had eliminated these currents. In the longer term, breaching of the mouth seems to influence species composition and diversity. After an extended period of separation from the sea, the benthic macrofauna appears to develop towards that of a coastal lake. The unpredictable, catastrophic disturbance caused by opening the mouth, however, interrupts this development by eliminating the 'lagoonal' species and thereby also maintaining very low species diversities. (Author's abstract)
W88-10868

FRENCH HAUT-RHONE: HISTORICAL GEOGRAPHY AND MANAGEMENT OF A RIVER (LE HAUT-RHONE FRANCAIS GEOGRAPHIE HISTORIQQUE ET GESTION D'UN FLEUVE),
Lyon-3 Univ. (France).
J. P. Bravard.
La Houille Blanche, No. 1, p 45-52, 1988. 6 fig, 4 ref. English summary.

Descriptors: *River regulation, *Navigation, *Rhone River, *France, History.

This historical geographical study concerns the River Rhone between Geneva and Lyon. Human relations with the fluvial environment and the effects of human actions on the dynamics of river changes, e.g., improvements for navigational purposes, are considered. An understanding of the Haut-Rhone from an historical perspective is important in the face of recent discussions concerning its conservation and rehabilitation. (Sand-PTT)
W88-10906

DEWATERING AND WATER SUPPLY CONSIDERATIONS: NEW BONNEVILLE NAVIGATION LOCK,
Sweet, Edwards and Associates, Inc., Redmond, WA.
For primary bibliographic entry see Field 2F.
W88-11126

SUITABILITY OF GLACIAL GEOLOGY AND HYDROGEOLOGY OF NORTHWEST WASHINGTON FOR SITING WASTE MANAGEMENT FACILITIES,
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 5E.
W88-11129

EFFECTS OF DEPLETION OF THE OGALLALA AQUIFER AND ACCOMPANYING IMPACT ON ECONOMIC AND AGRICULTURAL PRODUCTION IN THE SOUTHERN HIGH PLAINS REGION OF THE UNITED STATES,
Environmental Protection Agency, Dallas, TX. Region VI.
J. M. Lehe.
IN: Proceedings of the Association of Ground Water Scientists and Engineers Southern Regional Groundwater Conference. National Water Well Association, Worthington, OH. 1986. p 410-426, 2 fig, 3 tab, 19 ref.

Descriptors: *Groundwater mining, *Groundwater management, *Economic impact, *Agriculture, *Irrigation, *Water policy, *Ogallala Aquifer, *High Plains Region, Semiarid lands, Prices, Legal aspects, Public investment, Water costs, Aquifers, Land appraisals.

The semi-arid High Plains Region of the U.S. has experienced dramatic increases in agricultural productivity during the past three decades due to water-mining for irrigation. The consequence has been the decline of the Ogallala Aquifer, which has been mined as normal mineral depletion for economic benefit. Value of groundwater used in agriculture relates to land and crop values. Real estate credit amounts and sale prices indicate a slight downward trend. These measures are influenced by many factors. Due to their specificity, they may not be a reliable guide to the general value of land. Substitution from other regions of the nation of agricultural production is a significant portion of natural production. Cultural, especially legal and institutional, changes offer the key to extending the usefulness of this resource. Such adjustments could include adaptions in cropping patterns, reduced levels of beef consumption, public groundwater ownership with accompanying use restrictions and raising water prices (service charges). Conjunctive management of surface and groundwater is likely to optimize resource utilization and protection. (See also W88-11182) (Author's abstract)
W88-11211

7. RESOURCES DATA

7A. Network Design

CONSTRUCTION OF GEODETIC NETWORKS FOR STUDYING CRUSTAL MOVEMENTS WHEN CREATING HYDRAULIC STRUCTURES IN SEISMIC REGIONS,
For primary bibliographic entry see Field 8E.
W88-10221

CURRENT STATE AND WAYS TO DEVELOP ENGINEERING GEOPHYSICS,
For primary bibliographic entry see Field 8E.
W88-10426

EVALUATION OF AN AQUATIC ECOREGION CLASSIFICATION OF STREAMS IN ARKANSAS,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W88-10458

SATELLITE REMOTE SENSING REQUIREMENTS FOR HYDROLOGY AND WATER MANAGEMENT FROM THE MID-1990S, IN RELATION TO THE COLUMBUS PROGRAMME OF THE EUROPEAN SPACE AGENCY,
Bristol Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-10483

GROUNDWATER MONITORING NETWORK RATIONALIZATION USING STATISTICAL ANALYSES OF PIEZOMETRIC FLUCTUATION,
Agriculture and Water Resources Research Centre, Baghdad (Irag).
S. B. Jawad, and K. A. Hussien.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 2, p 181-191, April 1988. 4 fig, 2 tab, 12 ref.

Descriptors: *Piezometers, *Hydrology, *Geohydrology, *Network design, *Groundwater monitoring, *Statistical methods, *Monitoring wells, Model studies, Mathematical studies, Hydrology, Geohydrology, Erbil Basin, Iraq, Monitoring wells, Aquifers, Groundwater.

The use of a multivariate analysis approach to rationalize a piezometric network is not new. The utilization of its results for the distinction of zones with particular fluctuation patterns is a contribution which has fruitful outcomes. This technique was applied with success to the Erbil hydrogeological basin in Iraq where a network of only 15 wells out of an original network of 68 wells (monitored for about three years) is retained for the purpose of future monitoring of the yearly changes in the aquifer storage. This new network represents at least four fluctuation patterns of the piezometric surface in two different aquifers. (Author's abstract)
W88-10493

RECOMMENDATIONS FOR WATER QUALITY INVESTIGATION OF DRINKING WATER SUPPLY RESERVOIRS IN CZECHOSLOVAKIA,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 5B.
W88-10805

SIMPLE SELF-RELEASING CORESAMPLER,
Ceskoslovenska Akademie Ved, Prague. Ustav Krajinne Ekologie.
V. Hruska.
Limnologica LMNOA8, Vol. 17, No. 2, p 259-261, October 1986. 1 fig, 1 tab, 7 ref.

Descriptors: *Core drilling, *Sampling, *Mud, *Testing procedures, *Field tests, Technology, Data collection.

A sampler with a sampling area of 22 sq cm commercially-produced rubber ball as the main part of the closing valve. While penetrating into mud, the tube shifts into the bayonet socket and moves the valve support. When the valve is released, it drops and closes the sampling tube. Comments on the size of the sieves are included. Low volumes of mud (220-660 ml if samples are 10-30 cm thick) permit use of relatively small sieves. A diameter of 23 cm and 415 sq cm of area have proven to be convenient. This size permits sufficiently rapid washing during field sampling with successive washing of different sample fractions in the bucket directly in a boat if necessary. (Author's abstract)
W88-10812

APPLICATION OF SEISMIC, EM AND RESISTIVITY TECHNIQUES TO DESIGN A GROUND WATER MONITORING PROGRAM AT A LANDFILL IN NORTHWESTERN ILLINOIS,
Geotechnology, Inc., St. Louis, MO.
M. Ehrlich, and L. C. Rosen.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 189-206, 10 fig.

Descriptors: *Monitoring, *Path of pollutants, *Network design, *Groundwater, *Landfills, *Waste disposal, Geophysics, Seismology, Electromagnetic waves, Resistivity, Illinois, Domestic wastes, Industrial wastes, Geology, Groundwater-surface relations, Soil surveys, Water quality control.

An approximately 80-acre site had been used as an uncontrolled landfill for municipal and industrial wastes. Site geology included shale overlain by sand, till, and fill. Several streams intersect the site and groundwater was encountered at depths ranging from 0 to 15 feet (4.6 m). Seismic refraction, electromagnetic (EM), and resistivity geophysical techniques were employed. Equipment used included a multichannel signal-enhancement seismograph with filter capabilities, an electromagnetic system, and an earth-resistivity meter. Data obtained from the survey helped determine lithology, define the limits of fill material and aid design of the soil-boring and groundwater-monitoring program. (See also W88-11031) (Author's abstract)
W88-11043

INVESTIGATING SUBSURFACE FUEL RELEASES USING AMBIENT TEMPERATURE HEADSPACE ANALYSIS,
ERT, Fort Collins, CO.
T. Holbrook.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 249-265, 5 fig, 2 tab, 6 ref.

Descriptors: *Path of pollutants, *Groundwater, *Groundwater pollution, *Fuel, *Underground storage, *Leakage, Ambient-temperature headspace analysis, Urban areas, Soil analysis, Water sampling, Urban hydrology, Soil gases, Soil contamination, Hydrocarbons, Pollutant identification, Case studies, Wells.

Investigations of subsurface fuel releases in an urban setting are complicated by a variety of factors. A preliminary investigation is necessary to review existing information available for a given site prior to formulating plans for soil or groundwater sampling. Most critical at this stage is the identification of buried water, sewer, or other utility lines that form the 'urban hydrogeology' of the site. The next recommended step is to plan a soil-vapor survey to define the occurrence of fuel vapors in the vadose zone. Several soil-vapor survey methods for obtaining specific and relative levels of contamination at several points are available. Following a protocol for ambient-temperature headspace (ATH) analysis yields valuable data on relative volatile-hydrocarbon contamination of soils near leaking underground storage tanks. Results of a recently-completed laboratory study support the validation of the ATH method as a sensitive hydrocarbon-detection method. A case study in which this method has been used is discussed. The design, location, and number of monitoring and recovery wells can be optimized using ATH data. (See also W88-11031) (Author's abstract)
W88-11046

DESIGN AND IMPLEMENTATION OF AN EFFECTIVE SOIL GAS MONITORING PROGRAM FOR FOUR-DIMENSIONAL MONITORING OF VOLATILE ORGANICS IN THE SUBSURFACE,
IEP, Inc., Westerville, OH.
G. L. Yeates, and D. M. Nielsen.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 283-307, 4 fig, 1 tab, 8 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Soil gases, *Organic compounds, *Monitoring, *Network design, Design criteria, Spatial distribution, Temporal distribution, Sampling, Chemical analysis, Data interpretation, On-site data collections, Pollutant identification, Observation wells, Cleanup operations.

One of the most innovative and versatile techniques available to groundwater scientists today for defining and characterizing subsurface contamination caused by volatile organics is soil-gas monitoring. A network of soil-gas probes can be designed and installed to monitor the movement and changes in the chemistry of subsurface volatile-organic contamination four-dimensionally, i.e., areally, with depth, and over time. To ensure that representative soil-gas samples are collected for analysis, a number of site-specific, system-wide, and individual probe-design criteria must be developed prior to the installation of a soil-gas monitoring network. In addition, careful planning must go into the design of the soil-gas sample collection and analysis phase of the soil-gas program to ensure that analytical results obtained are both accurate and precise. It is not possible to design an effective soil-gas monitoring system using a 'cookbook' approach. Instead, all site-specific variables must be examined and incorporated into the system design. Using a database developed from a series of soil-gas monitoring probes it is possible to identify sources of contamination, determine soil-gas migration routes, assess the amount of time that has passed between the release of the contaminant and monitoring by identification of contaminant decay products (natural and/or biodegradation), assist in the location of groundwater monitoring wells, and monitor the effectiveness of site-remediation activities. (See also W88-11031) (Shidler-PTT)
W88-11049

UNIFIED GROUND WATER MONITORING PROGRAM,
Waste Management of North America, Southfield, MI. Northwest Regional Office.
R. L. Stegen, W. J. Gresham, and M. E. Carlson.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 377-405, 1 fig, 9 tab, 27 ref.

Descriptors: *Monitoring, *Water quality control, *Sanitary landfills, *Groundwater, *Groundwater movement, *Leaching, *Groundwater pollution, Cost analysis, Path of pollutants, Chemical oxygen demand, Chlorides, Iron, Manganese, Sodium, Specific conductivity, Phenols, Organic compounds, Public health, Environmental effects, Ketones, Tolune, Volatile organic compounds.

The objective of a groundwater monitoring program at a sanitary landfill is to determine if leachate constituents have entered the groundwater. A selection process was devised to evaluate leachate constituents and includes considering the presence, mobility, persistence, analytical reliability, concentration contrast, and analytical cost of each constituent detected in the leachate. A list of recommended indicator parameters was established which includes: ammonia, chemical oxygen demand, chloride, iron, manganese, sodium, specific conduct-

ance, total phenolics, and volatile organics (1,1-dichlorethane, 1,2-trans-dichloroethylene, methyl ethyl ketone, methylene chloride, and toluene). Should contaminant migration be detected, a risk assessment needs to be conducted to determine the associated public health and environmental impacts. (See also W88-11031) (Author's abstract)
W88-11054

MIDWESTERN MONITORING WELL INSTALLATION AND DEVELOPMENT,
Geotechnology, Inc., St. Louis, MO.
K. D. Olson.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 407-415, 2 fig.

Descriptors: *Monitoring, *Waste disposal, *Groundwater, *Wells, Hazardous materials, Contracts, Specifications, Engineering, Illinois, Soil types, Water sampling, Drilling, Water table, Well filters, Water quality control.

A case history is utilized to review some of the problems encountered with monitoring well installation at a midwestern hazardous-waste site; the role of contractual specifications and the use of practical field-engineering judgement are additionally reviewed. An Illinois EPA site south of Chicago called for the installation of 15 monitoring wells allowing for the monitoring of groundwater in a thick sequence of sands and silts underlain by a competent and relatively impermeable clay. Well installation problems included heaving sands and sample recovery during drilling, installation of filter packs and seals in high water table conditions during well emplacement, and filter-pack stabilization during well development. (See also W88-11031) (Author's abstract)
W88-11055

INSTALLATION OF OBSERVATION WELLS: THE HIDDEN COSTS,
Groundwater Technology, Inc., North Ridgeville, OH.
L. L. Perisse, and P. M. Yaniga.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 443-456, 2 fig, 3 tab.

Descriptors: *Wells, *Drilling, *Water quality control, *Groundwater, *Observation wells, *Costs, Underground storage, Storage tanks, Leakage, Engineering personnel, Aquifer systems, Perched water table, Groundwater barriers, Clays, Groundwater pollution, Case studies, Potable water, Design criteria, Water sampling, Construction costs, Construction materials.

With the advent of an ever-increasing focus on underground storage tanks, and the leaks and losses associated with them, comes an increase in the number of required observation wells installed throughout the country. In midwestern states, multi-aquifer systems often exist wherein a perched water table overlies one or more deeper aquifers. These aquifers may be separated by confining layers, most often clays. As a result, much of the contamination that originates from a point source above or slightly below the ground surface is fortunately restricted to this perched, limited-use water table. One of the two case studies presented describes an unsupervised drilling program which resulted in the penetration of both the shallow perched zone and a deeper potable aquifer via poor well design and installation. As a result of this oversight, a considerable amount of additional cost was incurred. This included additional sampling, additional properly installed and constructed well installations into the lower aquifer to prove the presence of absence of induced impacts, plugging the improperly-constructed wells, and addressing the potential potable water supply contamination. The other case study highlighted describes wells which were properly designed (from the physical standpoint) to monitor geologic and hydrogeologic information; however, the most important factor to be considered at this site, well material, was overlooked. Seven 2-inch diameter PVC observation wells had been installed, yet all the potential contaminants whose possible presence was being investigated are chemically incompatible with PVC materials. Consequently, it will be necessary to replace the PVC with stainless or galvanized steel, at a substantial additional cost. (See also W88-11031) (Shidler-PTT)
W88-11057

DESIGN OF LYSIMETER LEAK DETECTOR NETWORKS FOR SURFACE IMPOUNDMENTS AND LANDFILLS,
In-Situ, Inc., Laramie, WY.
A. C. Bumb, C. R. McKee, R. B. Evans, and L. A. Eccles.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 381-403. 16 fig, 2 tab, 37 ref. EPA Cooperative Agreement CR 812189-01-0.

Descriptors: *Water pollution control, *Network design, *Lysimeters, *Monitoring, *Leakage, *Landfills, *Design criteria, Soil water, Vadose water, Reservoirs, Contamination, Hazardous materials, Mathematical models.

Sampling of soil pore moisture in the vadose zone underneath land disposal facilities (landfills and surface impoundments) for hazardous waste has been suggested as an 'early warning system' to detect leakage from these facilities. Some states require vadose zone moisture sampling at such sites. Given a leak of a particular size, mathematical models can estimate the necessary moisture sample volume collection times and lysimeter spacings to guarantee detection of the leak. Examination of 47 hazardous waste sites existing in 1984 indicated that most were located in areas with water tables too shallow to permit vadose zone detection monitoring. Several of the sites with adequate vadose zones had soils which could be described as loamy sand, silt loam, or silty clay. For a particular loamy sand with a saturated hydraulic conductivity of 0.000001 cm/sec, the maximum ceramic lysimeter spacing is 15.5 feet at a depth of 30 feet to collect a moisture sample of 10 ml in one week. For a silt loam, maximum lysimeter spacing would be 17 feet at a depth of 15 feet. For silty clays, the maximum lysimeter spacing is 7 feet at a depth of 2 feet; maximum emplacement depth is about 9 feet. Calculations show that in some soils, suction lysimeters will not be able to collect usable moisture samples. Since soil properties vary widely, appropriate soil measurements and modeling must be performed at each disposal facility to estimate lysimeter performance and to select locations for emplacement. (See also W88-11121) (Author's abstract)
W88-11141

STATISTICAL ASPECTS OF DESIGNS FOR STUDYING SOURCES OF CONTAMINATION,
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
W. S. Liggett.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 22-40, 5 fig, 3 tab, 22 ref.

Descriptors: *Data acquisition, *Network design, *Water pollution sources, *Groundwater pollution, *Monitoring, *Statistical analysis, Waste management, Sampling, Environmental control, Water quality.

A design for studying sources of environmental contamination must start with a basis for distinguishing the contamination of interest from the background. As part of this basis, the design should provide a method for assessing the sampling and measurement error. Because of problems with reports of none detected, the design should also include a plan for analyzing intermediate laboratory results in addition to the reported values. This paper discusses these aspects of design in the context of monitoring the groundwater around a waste management facility. A design appropriate for spatially and temporally varying backgrounds is proposed and illustrated with monitoring results from Alabama and Florida. To assess the sampling error, the proposed design specifies resampling each well after a period of a few days. Experiments to check this procedure are suggested. The proposed design incorporates and supplements the Environmental Protection Agency laboratory method for total organic halide. In addition, some difficult design problems that involve nonnormality and nonlinear measurement methods. (See also W88-11158) (Author's abstract)
W88-11161

QUALITY ASSURANCE PROJECT PLANS - A KEY TO EFFECTIVE COOPERATIVE MONITORING PROGRAMS,
Environmental Protection Agency, Washington, DC. Quality Assurance Management Staff.
M. W. Brossman, T. J. Hoogheem, and R. C. Splinter.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 53-61.

Descriptors: *Quality control, *Project planning, *Monitoring, *Administrative aspects, *Data acquistions, Interagency relations, Environmental Protection Agency, Environmental control, Governmental interrelations.

The use of cooperative monitoring programs, involving the co-mingling of data of the regulated community and the 'regulators,' can lead to effective utilization of resources and contribute to cooperative solutions to pollution control programs. Such benefits can only be realized, however, under controls that ensure the comparability and validity of data obtained through well-defined roles and work plans. A key to this control is the Work/Quality Assurance (QA) Project Plan developed cooperatively by a team consisting of federal, industry and state/municipal representatives. A comprehensive Work/Quality Assurance Project/Work Plan Guidance document has been developed in the Office of Water, U.S. Environmental Protection Agency (EPA), which should effectively meet QA requirements for a wide range of users and types of water-monitoring tasks. This guidance document is designed to cover all aspects of water environmental measurement from field sampling through laboratory analysis and data reduction and, where applicable, computer input. The document integrates a work plan with a QA plan eliminating the dual effort of overlapping plan developments and assuring practical incorporation of quality assurance/quality control. In addition, the combination of the work plan and QA plan provides a comprehensive basis to establish sound coordination and agreement for cooperative monitoring tasks. This guidance document is currently in pilot implementation throughout the United States. (See also W88-11158) (Author's abstract)
W88-11163

WASTE MANAGEMENT AND GROUND WATER MONITORING PRACTICES: A COMPARISON OF TECHNIQUES IN THE BEAUMONT FORMATION, TEXAS CITY, TEXAS,
Texas Water Commission, Austin.
For primary bibliographic entry see Field 5E.
W88-11189

MONITORING A HYDROCARBON LAND TREATMENT FACILITY IN CLAYEY GLACIAL TILL,
Tellus Consultants, Inc., Minneapolis, MN.
R. J. Kadwell, and J. A. Magner.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 329-339, 3 fig, 8 ref.

Descriptors: *Land treatment, *Soil contamination, *Monitoring, *Hydrocarbons, *Crude oil, *Cleanup operations, Hydrology, Vadose water, Geology, Hydrogeology, Saturation zone, Plumes, Aquicludes, Aquitards, Minnesota, Oil spills.

Group 7A—Network Design

Background and site-specific information are provided for the construction of a land treatment facility designed to treat crude oil-contaminated soil from an oil spill that occurred in November 1985 in central Minnesota. The geologic setting, site hydrogeology, and site-specific vadose hydrology also are described. The site evaluation showed that the upper zone of saturation at the site was separated from the treatment zone by approximately 10 to 15 feet of clayey, glacial till that acts as an aquiclude/aquitard. The authors concluded, based on these hydrogeologic conditions, that monitoring the saturated zone would not provide early warning for potential contaminant release from the treatment zone. However, since the upper unsaturated drift contained significant secondary porosity and permeability that could allow 'bypass' flow to leave the treatment zone, it was concluded that vadose zone monitoring as presented here was appropriate for this site and would provide early warning of potential contaminant release from the treatment zone. Therefore, the lysimeter system described is the primary monitoring system chosen. (See also W88-11213) (Fremann-PTT)
W88-11233

STRATEGY FOR DETECTING SUBSURFACE ORGANIC CONTAMINANTS,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11235

FIELD AND INTERPRETATION TECHNIQUES FOR DELINEATING SUBSURFACE PETROLEUM HYDROCARBON SPILLS USING SOIL GAS ANALYSIS,
Tracer Research Corp., Tucson, AZ.
For primary bibliographic entry see Field 5A.
W88-11239

FRONTIERS OF MASSIVELY PARALLEL SCIENTIFIC COMPUTATION.
For primary bibliographic entry see Field 7C.
W88-11264

7B. Data Acquisition

COMPARISON OF EXTRACTION METHODS IN THE DETERMINATION OF ADENOSINE TRIPHOSPHATE (ATP) IN PHYTOPLANKTON AND SESTON,
Finnish Inst. of Marine Research, Helsinki.
E. Lahdes, J. M. Leppanen, and I. Makinen.
Aqua Fennica AQFEDI, Vol. 17, No. 1, p 43-49, 1987. 3 fig, 2 tab, 20 ref.

Descriptors: *Biochemical tests, *Adenosine triphosphate, *Seston, *Biomass, *Phytoplankton, *Aquatic plants, *Biochemistry, Metabolism, Chlorophyll, Brackish water, Lakes, Chlorophyta, Comparison studies.

The efficiency of boiling Tris and glycine buffers and cold, 1%, 5% and 10% (weight/volume) solutions of TCA was tested in the extraction of adenosine triphosphate (ATP) from phytoplankton cultures and natural plankton communities of lake and brackish water. Extraction with TCA solutions yielded the highest ATP concentrations in quantitative determination of ATP in cultures. 10% TCA was the most efficient especially for populations containing green algae. There was no significant difference between the extractants in the case of lake and brackish water samples For rapid detection of the relative amount of living biomass, 1% TCA seemed to be the most suitable. Tris and glycine buffers tended to yield the lowest ATP concentrations and boiling extractants are difficult to handle in the field. The ATP content of the cells and the ratio of ATP to chlorophyll a varied with the extraction efficiency, physiological state of the cells, and species composition of the samples. (Author's abstract)
W88-10114

INVENTORY OF RIVER BASIN CHARACTERISTICS IN FINNISH CONDITIONS USING SATELLITE IMAGERY,
Technical Research Center of Finland, Helsinki.
R. Kuittinen, and Y. Sucksdorff.
Aqua Fennica AQFEDI, Vol. 17, No. 2, p 97-114, 1987. 12 fig, 9 tab, 11 ref.

Descriptors: *Finland, *Satellite technology, *River basins, *Watercourses, *Channel morphology, *Remote sensing, Geography, Water quality, Monitoring, Flow rates, Data acquisitions, Streamflow, Surveys.

The Technical Research Center of Finland and National Board of Waters and Environment have together developed a system for determining basin characteristics using satellite imagery. The system is flexible, so that different kinds of images can be used and the results can be integrated into the geographic information system of th National Board of Waters and Environment, which is based on a GIS program called FINGIS, developed by the National Board of Survey of Finland. This method allows updating of the information on the physiographic factors when needed and thus facilitates forecasting of the quantity and quality of the water and monitoring of the watercourses themselves. The results have been promising and operational interpretations can be started. (Author's abstract)
W88-10117

UTILITY OF THE MORPHOEDAPHIC INDEX IN THE PREDICTION OF FISH YIELD IN FINNISH LAKES,
Turku Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10121

PITFALLS IN THE AQUATIC PHOTOCHEMISTRY TESTING OF CHLORINATED AROMATIC COMPOUNDS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Ecotoxicology, Environmental Chemistry, and Drinking Water.
For primary bibliographic entry see Field 5A.
W88-10139

PHOTOLYSIS OF RHODAMINE-WT DYE,
Geological Survey, NSTL Station, MS.
D. Y. Tai, and R. E. Rathbun.
Chemosphere CMSHAF, Vol. 17, No. 3, p 559-573, 1988. 3 fig, 7 tab, 27 ref.

Descriptors: *Tracers, *Rhodamine dyes, *Groundwater movement, *Streamflow, *Dyes, *Photolysis, Chemical reactions, Sunlight, Fluorescence, Humic acids, Seasonal variations, Synergistic effects, Path of pollutants, Dispersion, Mixing.

Photolysis of rhodamine-WT dye under natural sunlight conditions was determined by measuring the loss of fluorescence as a function of time. Sunlight photolysis of rhodamine-WT dye in water has a slow but measurable rate. For natural water containing high humic substances, the photolysis rate may increase significantly. Rate-coefficients at 30 N latitude ranged from 0.0477/day for summer to 0.0316/day for winter. Experimental coefficients were in good agreement with values calculated using a laboratory-determined value of the quantum yield. Low pH of the water may cause initial quenching of the fluorescence but does not affect the photolysis rate. With the laboratory-determined quantum yield, the photolysis rate can be calculated as a function of the latitude, season, and depth of water. It is suggested in conducting long time-period hydrological measurements that an estimate of the dye loss due to sunlight photolysis be calculated. (Friedmann-PTT)
W88-10144

MEASURED AND MODELED FATE OF DISPERSE YELLOW 42 IN AN OUTDOOR POND,
Bayreuth Univ. (Germany, F.R.). Fakultaet fuer Biologie, Chemie, Geowissenschaften.
K. W. Schramm, M. Hirsch, R. Twele, and O. Hutzinger.
Chemosphere CMSHAF, Vol. 17, No. 3, p 587-595, 1988. 9 fig, 1 tab, 8 ref. Umweltbundesamt, Berlin (No. 10605032).

Descriptors: *Tracers, *Dye dispersion, *Photolytic degradation, *Dyes, *Path of pollutants, *Hydrologic models, *Chemical reactions, *Fate of pollutants, Statistical analysis, Model studies, Ponds.

The dye Disperse Yellow (DY 42, C.I. No. 10338) was tested in an outdoor pond to compare its measured fate with modeled fate data. Models used were Mackay 4 and Exams 2. All important parameters such as physiochemical properties and biological and chemical reaction rates, which determine the fate of the chemical, were introduced into the models. There was good agreement between the calculated and measured behavior of DY 42. Mackay 4 simulated the fate of the substance slightly better than Exams 2 as shown by statistics. (Author's abstract)
W88-10145

MERITS OF MACROFAUNAL COLONIZATION OF INTERTIDAL MUDFLATS FOR POLLUTION MONITORING: PRELIMINARY STUDY,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5A.
W88-10158

DETERMINATION OF MO(VI) IN TAP WATER AND SEA-WATER BY DIFFERENTIAL-PULSE POLAROGRAPHY AND CO-FLOTATION,
Cadiz Univ. (Spain). Faculty of Sciences.
J. L. Hidalgo, M. A. Gomez, M. Caballero, R. Cela, and J. A. Perez-Bustamante.
Talanta TLNTA2, Vol. 35, No. 2, p 301-305, April 1988. 2 fig, 5 tab, 23 ref.

Descriptors: *Water analysis, *Molybdenum, *Drinking water, *Seawater, *Polarographic analysis, Trace metals, Natural waters, Potable water.

The combination of classical polarographic methods and a co-flotation technique does not seem to have been used in the past. The new method described here is for the microdetermination of Mo(VI) in natural waters and seawater by differential pulse polarography using the catalytic wave produced by Mo(VI) with nitrate following preconcentration by co-flotation with Fe(III) hydroxide. For seawater samples, hexadecyltrimethylammonium bromide and octadecylamine were used as the surfactants. For natural water samples, only hexadecyltrimethylammonium bromide was needed. Once suitable experimental conditions had been found for the determination of trace levels of Mo(VI), samples of tap water and seawater were analyzed. Good reproducibility was obtained with average values of 0.7 ng/ml for the tap water samples and 5.7 ng/ml for the seawater. This approach appears appropriate because the high concentration factor obtained by flotation makes it possible to use the polarographic methods for determination of trace metal levels below the detection limits normally attainable by these techniques. (Miller-PTT)
W88-10166

GEOELECTRICAL PROPERTIES OF SELECTED ROCK AND WATER SAMPLES FROM SAN SALVADOR ISLAND, BAHAMAS,
Akron Univ., OH. Dept. of Geology.
W. G. Weir, and A. W. G. Kunze.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 25, No. 2, p 257-263, May 1988. 9 fig, 5 tab, 13 ref.

Descriptors: *Hydrological data collection, *Geophysics, *Aquifer characteristics, *Resistivity, *Carbonate rocks, *Limestone, *Electrical properties, Electrical studies, Regression analysis, Least squares method, Bahamas, San Salvador Island, Archie Relationship, Groundwater, Chromatogra-

phy, Water analysis, Water sampling, Rocks, Chromatography.

Geophysical techniques provide the most practical way to detect the extent and geometry of freshwater aquifers on most Bahamian Islands. Eight rock samples and four water samples were collected from San Salvador Island, Bahamas, in order to test their electrical properties. Helium porosities of the rock samples ranged from 8.24% to 36.06%. The water samples were analyzed by ion chromatography and four corresponding equivalent NaCl solutions were prepared (with NaCl concentrations ranging from 32.30 Kppm to 0.25 Kppm). Resistivity values (at 1 KHz) of the equivalent NaCl solutions ranged from 0.71 to 70.55 ohm-ft. Rock resistivities were determined (at 1 KHz) under both dry and saturated (with the prepared NaCl solutions) conditions. Resistivity values under dry conditions ranged from 196,000 to 3.12 times ten to the 7th power ohm-ft. Resistivity values measured under saturated conditions were used to calculate formation factors (F) for each saturation phase. Cementation exponents (m) and tortuosity factors (a) were determined from least squares regression lines of log F versus log phi plots. The resulting mean values of m(2.4) and a(0.57) indicate that the electrical behavior of San Salvador limestones resembles that of unconsolidated sands and does not obey the basic Archie relationship ($F=1/phi\ sq$) for carbonates. The basic Archie relationship, however, gives acceptable results for porosities in the range of 20-32%. Since this is the porosity range most commonly found on carbonate islands such as San Salvador, the use of the basic Archie formula for the interpretation of Bahamian aquifer resistivity data should yield adequate results. (Author's abstract)
W88-10169

EFFICIENT METHOD FOR DETERMINING THE TOTAL AMOUNT OF DISSOLVED FREE AMINO ACIDS IN NATURAL WATERS BY FLUOROMETRIC ANALYSIS,
Hokkaido Univ., Sapporo (Japan). Research Inst. of North Pacific Fisheries.
H. Yoshida.
Hokkaido University. Faculty of Fisheries Bulletin, Vol. 36, No. 4, p 210-215, 1985. 3 fig, 2 tab, 6 ref.

Descriptors: *Natural waters, *Amino acids, *Seawater, *Fluorometry, *Water analysis, Particulate matter, Phtalaldehyde.

The total amount of dissolved free amino acids in natural waters was determined fluorometrically by the use of the smaller amount of the reagent including 0-phtalaldehyde (6.44 mg/l as the final concentration). By this method, a low level of dissolved free amino acids (0.016 micromol/l leucine units) could be determined without the desalting and preconcentration of the seawater sample. Variation coefficient was 12% at 0.1 micromol/l level, 0.64% at 1 micromol/l level, and 1.9% at 10 microm/l, in leucine units. The method can be applied to combined and particulate amino acids by means of an adequate pretreatment and hydrolysis. (Author's abstract)
W88-10190

DIRECT DETERMINATION OF PERMEABILITY OF CLAY UNDER EMBANKMENT,
Laval Univ., Quebec. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W88-10193

MONITORING WELL FILTER PACK AND SCREEN SLOT SELECTION: A REASSESSMENT OF DESIGN PARAMETERS,
For primary bibliographic entry see Field 8A.
W88-10243

ELUTION PATTERNS OF AQUATIC HUMUS IN SIZE EXCLUSION CHROMATOGRAPHY BASED ON DIFFERENT ELUANTS,
Joensuu Univ. (Finland). Mekrijaervi Research Station.
O. Lehto, J. Aho, and E. Vahasarja.
Aqua Fennica AQFEDI, Vol. 16, No. 1, p 47-55, 1987. 5 fig, 6 tab, 14 ref.

Descriptors: *Chromatography, *Decomposing organic matter, *Water analysis, *Natural waters, *Lakes, *Elution patterns, Hydrogen ion concentration, Buffers, Adsorption, Filtration, Ions, Gel filtration, Aquatic humus, Finland, Lake Mekrijarvi.

The effect of different eluants used for samples collected from Lake Mekrijarvi on the patterns of size exclusion chromatograms is analyzed. The ultimate purpose was to improve the techniques for separating humic and fulvic acids from other components of water samples for chemical, limnological and biological studies. Elution patterns of aquatic humus were analyzed with a Sephadex G-100 column using five different series of eluants and maintaining otherwise constant conditions. The eluants were: (1) pH-regulated distilled water, (2) NaCl solutions with different ionic strengths and constant pH, (3) phosphate buffers with increasing pH and conductivity, (4) Tris buffers with increasing pH and decreasing conductivity, and (5) urea solutions of different concentrations. At neutral pH and low ionic strength, dissolved humic matter consists of five component fractions, which can be detected with combined UV- and fluorescence monitoring. At higher ionic strength, the number of peaks is reduced from five to two - the excluded peak and the retarded peak near the inclusion limit of the column. The pH of the eluant seems to effect changes in the structural features of the molecular species in the sample and the ionic strength of the eluant on the adsorptive and repulsive properties of the gel matrix, which further influences the chromatographic elution profiles. (Author's abstract)
W88-10291

DILUTION EFFECTS ON THE FLUORESCENCE MEASUREMENTS OF HUMIC LAKE WATERS,
Helsinki Univ. (Finland). Dept. of Limnology.
V. Pannanen, and J. Mannio.
Aqua Fennica AQDEI, Vol. 16, No. 2, p 143-149, 1987. 9 fig, 5 tab, 26 ref.

Descriptors: *Humic acids, *Water analysis, *Chemical analysis, *Decomposing organic matter, *Chemical analysis, *Fluorescence, *Wavelengths, Natural waters, Lakes, Finland, Optical measurements.

Lake waters, including some highly colored humic waters, were examined to determine appropriate dilutions for fluorescence measurements. Excitation and emission wavelengths of 350 nm and 455 nm, respectively, were used for optical measurements. An appropriate dilution (5,10, or 20-30 x) of samples improved results and generated clearer differences between individual samples. The most suitable dilutions varied according to the approximate concentration of humic matter. Therefore, the linearity of the dilutions should be controlled with several dilutions giving similar results. Results concerning the elements of scattering materials were preliminary. (Author's abstract)
W88-10299

EFFECTS OF FILTRATION ON THE DETERMINATION OF PHOSPHATE PHOSPHORUS IN RUNOFF WATERS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5A.
W88-10300

SENSITIVITY OF SURFACE WATERS TO ACIDIC DEPOSITION IN FINLAND,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W88-10306

STRONG AND WEAK ACIDS IN LAKE WATERS - A METHODOLOGICAL STUDY,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5A.
W88-10307

USING THE CAPILLARY SUCTION TIME DEVICE FOR CHARACTERIZING SLUDGE DEWATERABILITY,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and H. A. Davis.
Water Science and Technology WSTED4, Vol. 20, No. 1, p 203-205, 1988. 1 fig, 1 ref.

Descriptors: *Pulp and paper industry, *Sludge drying, *Filtration, *Capillary suction time device, *Measuring instruments, Sludge, Sludge conditioning, Wastewater treatment, Mathematical analysis, Mathematical equations.

A theory was developed to describe the operation of the capillary suction time (CST) device, an instrument invented by researchers at the Stevenage Laboratory in England for the simple, rapid, inexpensive measurement of the dewaterability potential of wastewater sludge. The theory was tested with various sludges. So far, it has not been meaningful to compare CST values from one plant to another, since CST measurements are unique to specific sludge solids concentrations and the instrument being used. An equation is presented for determining the filterability constant, which is demonstrated to be a true and fundamental descriptor of the ability of water to filter out of sludge. It is concluded that using the CST apparatus to calculate the filterability constant can elevate the status of the CST from a mere curiosity and in-plant operational control tool to a serious method for characterizing the dewaterability of sludges for research and development purposes. In the future, all research in which the CST is used should not report the results in seconds, but the instrument constant and filterability constant, so that the data can be related to other research and have lasting value. (Doria-PTT)
W88-10330

APPLICATION OF REMOTE SENSING TECHNIQUES FOR WATER QUALITY MONITORING,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
E. Seyhan, and A. Dekker.
Hydrobiological Bulletin HYBUD9, Vol. 20, No. 1/2, p 41-50, November, 1986. 6 fig, 2 tab, 26 ref.

Descriptors: *Remote sensing, *Monitoring, *Water quality, *Suspended solids, *Chemical properties, Water quality management, Water pollution, Reviews, Data acquisition, Radiation, Ultraviolet radiation, Infrared radiation, Infrared imagery, Microwaves, Electromagnetic waves, Reflectance, Optical properties, Aerial photography, Mapping, Vegetation, Color, Loosdrecht Lakes.

The determination of water quality using aerial survey techniques has been an object of intense study in the last decade because of the increased interest in environmental pollution. The multispectral characteristics of the signal received from water are a function of hydrological, biological, and chemical characteristics of water, and the physical properties of the remote sensor-related environment. The applications of remote sensing techniques for determining water depth and spectral signature, suspended material, and dissolved chemicals is reviewed. Spectral data encompassing the spectral region 0.36 microns and 2.36 microns showed that the detectability of water pollutants, using spectral signatures in the 0.4 to 0.9 micron range, is promising and feasible. In order to study the up-to-date remote sensing potential in water quality monitoring, a research project was proposed to study and detect the temporal and spatial variations in water quality of loosdrecht Lakes. (See also W88-10341 thru W88-10344, W88-10346 thru W88-10354 and W88-10359) (Doria-PTT)
W88-10345

MATHEMATICAL MODELLING OF PRIMARY PRODUCTION IN GREEN BAY (LAKE

MICHIGAN, USA), A PHOSPHORUS- AND LIGHT-LIMITED SYSTEM,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-10358

ANALYSIS OF SOME VELOCITY-AREA METHODS FOR CALCULATING OPEN CHANNEL FLOW,
Technical Univ. of Lisbon (Portugal). Inst. Superior Tecnico.
J. N. Hipolito, and J. M. Loureiro.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 3, p 311-320, June 1988. 5 fig, 2 tab, 3 ref.

Descriptors: *Open-channel flow, *Hydraulics, *Gaging, *Mathematical analysis, *Average velocity, *Stream gages, *Flow measurement, Flow, Mathematical studies.

A general equation is presented for the calculation of flow between two verticals in a cross section of a water course which, by considering a parameter (alpha), includes three of the calculation methods that are traditionally used. Assuming accurate values for the depths and for the normal component of the average velocity along each vertical, as well as for the distances between successive verticals, the behavior of the general equation was analyzed in the light of the values that could be attributed to alpha. Based on the analysis, it is recommended that alpha be assigned a value of unity (corresponding to Method 1, generally known as the mid- section method). (Author's abstract)
W88-10403

AUTOMATED NUMERICAL EVALUATION OF SLUG TEST DATA,
Shell Development Co., Houston, TX.
For primary bibliographic entry see Field 2F.
W88-10416

ARTIFICIAL TRACER TECHNIQUES FOR THE DETERMINATION OF THE STRUCTURE OF CONDUIT AQUIFERS,
University of Western Ontario, London. Dept. of Geography.
C. C. Smart.
Groundwater GRWAAR, Vol. 26, No. 4, p 445-453, July-August, 1988. 10 fig, 1 tab, 21 ref.

Descriptors: *Tracers, *Dye releases, *Groundwater movement, *Aquifer characteristics, *Karst hydrology, Structural models, Computer models, Conduit aquifers, Breakthrough curves, Mathematical models, Aquifer testing, Seasonal flow, Conduit flow, Springs, Castleguard Aquifer, Alberta.

Fluorescent dye tracer technology now permits accurate determination of tracer breakthrough curves in karst hydrology. Such data may be evaluated in terms of hydraulic processes of dispersion, divergence, convergence, dilution, and storage. The breakthrough curve reflects the character of ground-water flow and the structure of the ground-water conduit network, so that within constraints of regional geology, geomorphology, and hydrology, it is possible to interpret tracer breakthrough curves to produce a structural model of a karst aquifer. Such structural models provide a basis for further field investigations and rational computer modeling. An example of such an approach is taken from a series of tracer tests on the Castleguard karst aquifer, Alberta, Canada, and alpine karst with rapid conduit flow, and a strongly seasonal flow regime. A dimensionless recovery index is developed to identify the relationship between springs, and this shows that the behavior and configuration of the active aquifer vary dramatically with discharge. (Author's abstract)
W88-10418

CHARACTERIZING JOINTED SYSTEMS BY AZIMUTHAL RESISTIVITY SURVEYS,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
For primary bibliographic entry see Field 2F.
W88-10420

MEASUREMENT OF WATER DISCHARGE IN SHORT SECTIONS OF CONDUITS BY MEANS OF ORIFICES,
K. L. Valentini, B. M. Levin, and A. N. Lopatin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 105-107, August 1987. 2 fig, 7 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 48-49, February 1987.

Descriptors: *Discharge measurements, *Pressure conduits, *Pipe flow, *Orifices, *Orifice flow, *Symmetrical two-segment orifice, Pipes, Gaging, Hydraulic design, Outlets, Hydraulic engineering, Dams, Discharge coefficient.

Standard pipe regulating structures operating according to the scheme of lateral withdrawal from a canal and including a section of a precast reinforced-concrete pipe conduit passing under a dam are widely used in hydraulic engineering and reclamation systems. In view of the need to monitor the discharge of water in the discharge canal, the most convenient variant is that of combining the functions of regulating and monitoring the water delivery on the same structure by placing on a section of the conduit a constriction equipped with a differential pressure gauge or meter fall. Segmental orifices most completely correspond to properties needed, but their use is limited by the allowable length of a straight section of a pipe regulator. Schematic diagrams and test results of a symmetrical two-segment orifice designed by the authors are presented. From the hydraulic investigations, it was possible to sufficiently accurately (less than 1% error) to estimate the discharge coefficient of the symmetrical two-segment orifice on the basis of the discharge coefficient of a one-segment orifice. (VerNooy-PTT)
W88-10432

ASSESSMENT OF A SIMPLE SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF DISSOLVED ORGANIC CARBON IN FRESHWATERS,
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore.
New Zealand Journal of Marine and Freshwater Research, Vol. 21, No. 4, p 585-589, 1987. 2 fig, 2 tab, 25 ref.

Descriptors: *Dissolved organic carbon, *Chemical analysis, *Spectrophotometry, *Organic carbon, *Throughfall, *Stemflow, *Soil water, Hydrologic data collections, Streams, Water sampling, *Water analysis, Standard deviation, Regression analysis, Dissolved solids, New Zealand.

The ability of absorbance at 330 nm to predict dissolved organic carbon concentration was tested on samples of throughfall, stemflow, soil water, and stream water from the Maimai and Larry River catchments, Westland, New Zealand. Predictive ability for the combined samples was poor, but improved when the samples were split into groups of origin. For stream samples, the method gave standard errors of the estimate of 8 to 11% of the mean. Predictive ability was poorer in the other sample groups, especially throughfall and stemflow, presumably because of the occurrence of weakly colored organic compounds. The slope and intercept of the regressions varied with sample type. The spectrophotometric method is useful where a large number of samples need to be analyzed and where calibrations can be developed for specified types of organic-carbon-rich waters. (Author's abstract)
W88-10440

HAND-HELD BENTHIC CORE SAMPLER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
A. C. Miller, and C. R. Bingham.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 77-81, June 1987. 2 fig, 16 ref.

Descriptors: *Core sampling, *Bottom sampling, *Hand-held core sampler, Sediments, Suction, Pipes, Shallow water, Substrates, Benthic environment, Cost analysis, Construction methods.

A hand-held benthic corer which uses a plumber's pipe test plug to create suction is described. The sampler can be constructed with thin-walled conduit or PVC pipe. The test plug excludes water, detritus, aquatic plants, and creates suction that holds substrate in the barrel of the corer. This device is inexpensive, easy to construct, and can be used in shallow water by a person wading, from a boat at depths of about 2 m, or by a diver in deep water. Using a three-man diving crew, and five metal samplers (41 cm long with an internal diameter of 9.8 cm), approximately 100 cores were taken in 4-6 m of water in the lower Tennessee River during a four-hour period. In another trial, a corer 2 m long and with a 5 cm internal diameter was operated by one man in a small boat in shallow water at Eau Galle Lake, Wisconsin. The corer was carefully lowered through the vegetation to avoid collecting aquatic plants. With grab samplers and most coring devices this would have been impossible. (VerNooy-PTT)
W88-10454

GEOCHEMISTRY OF THE RHINE AND THE RHONE. 5: SYNTHESIS AND CONCLUSIONS (GEOCHIMIE DU RHIN ET DU RHONE. 5: SYNTHESE ET CONCLUSIONS),
Station Biologique de la Tour du Valat, Arles (France).
For primary bibliographic entry see Field 5A.
W88-10469

POPULATIONS OF CLADOCERA (CRUSTACEA), AS DESCRIBED BY THE HYDROLOGICAL FUNCTIONING OF STAGNANT WATERWAYS (LES PEUPLEMENTS DE CLADOCERES (CRUSTACES), DESCRIPTEURS DU FONCTIONNEMENT HYDROLOGIQUE DES BRAS-MORTS FLUVIAUX),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
For primary bibliographic entry see Field 2H.
W88-10471

SEDIMENT-WATER EXCHANGE OF PHOSPHORUS. THE INFLUENCE OF SEDIMENT DILUTION ON RADIOTRACER KINETICS (ECHANGES DE PHOSPHORE ENTR LES SEDIMENTS ET L'EAU. INFLUENCE DE LA DILUTION SUR LES CINETIQUES DE TRACAGE ISOTOPIQUE),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
J. Capblancq, L. Labroue, and J. C. Fardeau.
Annales de Limnologie ANLIB3, Vol. 22, No. 3, p 277-282, 1986. 4 fig, 2 tab, 19 ref.

Descriptors: *Phosphorus, *Sediment-water interfaces, *Radioactive tracers, *Limnology, *Kinetics, *Ion exchange, Solute transport, Chemical analysis, Path of pollutants, Chemical properties, Adsorption, Lake sediments.

The kinetic behavior of the Radiotracer 32P during exchange reactions between soluble phosphate ions and suspended sediments provides information on parameters that characterize P transport potentiality between the solid phase and the water. The method used enabled quantification of the isotopically exchangeable phosphorus in different types of sediments during a 24-hr exchange period (E sub 24). It is evident that sediment dilution involves the solubilization of exchangeable ion pool. An equation was developed that allows a calculation of the P concentration in water (Q) as a function of weight of suspended sediment (S). As the result of sediment dilution, both the release of the most labile P and the lengthening of the adsorption phase involve a modification of exchange kinetics. (Author's abstract)
W88-10480

SATELLITE REMOTE SENSING REQUIREMENTS FOR HYDROLOGY AND WATER MANAGEMENT FROM THE MID-1990S, IN RELATION TO THE COLUMBUS PRO-

GRAMME OF THE EUROPEAN SPACE AGENCY,
Bristol Univ. (England). Dept. of Geography.
E. C. Barrett, R. W. Herschy, and J. B. Stewart.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 1, p 1-17, February 1988. 6 tab, 12 ref.

Descriptors: *Columbus Programme, *Remote sensing, *Research priorities, *Europe, *Data acquisition, *Satellite technology, Measuring instruments, Policy making, Management planning, Geohydrology, Hydrology, Analytical methods, Research.

Satellite remote sensing is playing an increasingly important role in hydrology and water management. The USA, a world leader in such activities, is planning to develop and organize its system for Earth observation from satellite altitudes by the mid-1990s into a 'Space Station Program' including both manned and unmanned elements. Many other nations are debating and negotiating related intiatives. Those of the member states of the European Space Agency are expected to be organized in the multi-faceted 'Columbus Programme.' This promises to provide welcome new opportunities for remote sensing research and applications in many of the environmental sciences. For such opportunities to be embraced by hydrology and water management it is important that the hydrological community should identify its needs, and articulate and press its own case for these to be met, as the unmanned satellite 'Polar Platform' segment of the Columbus Programme develops. This paper presents the results of recent attempts (a) to synthesize the opinions of many hydrological scientists and water managers within western Europe regarding sensor requirements, and (b) from within the United Kingdom to establish and exemplify national requirements for preparatory program elements. (Author's abstract)
W88-10483

ELECTRIC LOG INTERPRETATION FOR THE EVALUATION OF SALT WATER INTRUSION IN THE EASTERN NIGER DELTA,
Ilorin Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W88-10484

ROLE OF CO2 IN LONG TERM STREAM ACIDIFICATION PROCESSES: A MODELING VIEWPOINT,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2H.
W88-10489

GROUNDWATER MONITORING NETWORK RATIONALIZATION USING STATISTICAL ANALYSES OF PIEZOMETRIC FLUCTUATION,
Agriculture and Water Resources Research Centre, Baghdad (Irag).
For primary bibliographic entry see Field 7A.
W88-10493

ESTIMATION OF A SINGLE PROBIT LINE FROM MULTIPLE TOXICITY TEST DATA,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
For primary bibliographic entry see Field 5C.
W88-10502

UNSUPERVISED LANDSAT CLASSIFICATION PROCEDURE APPLIED TO LAKE POSIONJARVI, NE FINLAND,
Oulu Univ. (Finland). Dept. of Astronomy.
J. Raitala, H. Jantunen, and J. Lampinen.
Annales Botanici Fennici ABOFAQ, Vol. 22, No. 1, p 173-182, 1985. 5 fig, 1 tab, 25 ref.

Descriptors: *Satellite, Technology, *Limnology, *Data interpretation, *Remote sensing, *Littoral environment, *Finland, Vegetation, Water depth, Classification, Spectral analysis, Lake Posionjarvi, Aquatic complexes.

The Landsat classification system, a remote sensing classification procedure based on spectral reflectances, was applied to the Lake Posionjarvi area in the Kuusamo region of northern Finland. The aquatic surfaces can be divided into seven classes which are connected with water depth, the nature of the bottom and the vegetation and water quality. The recognition of aquatic vegetation areas depends on the main life form since the amount of radiation reflected from the chlorophyll of the leaves varies with their position above, on or below the water surface. The Landsat classification system gives the best results if applied at a time when the influence of minor factors is at a minimum, since this allows the remaining main variables to be identified and mapped. The different classes represent different aquatic surface complexes and the change from one class to another enables environmental gradients to be determined. Information is still needed, however, on the extent to which the reflected spectrum and recorded data are affected by biological, physical and chemical variables. (Author's abstract)
W88-10508

PAPER CHROMATOGRAPHY AS A METHOD OF PHYTOPLANKTON COMMUNITY ANALYSIS,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. Eloranta.
Annales Botanici Fennici ABOFAQ, Vol. 23, No. 1, p 153-159, 1986. 3 fig, 1 tab, 26 ref.

Descriptors: *Species composition, *Chromatography, *Phytoplankton, *Pigments, *Aquatic populations, *Algae, Eutrophication, Biomass, Chlorophyll a, Spectrophotometry, Seasonal variation, Lakes.

The phytoplankton in a small, 7.5 m deep, eutrophic lake was monitored from the beginning of March to October 1983 using microscopic, direct spectrophotometric and paper chromatographic methods. The phytoplankton community consisted mainly of green algae and diatoms together with cryptomonads, dinoflagellates and euglenophytes. The phytoplankton biomass had two maxima (60-70 mg chlorophyll a/sq m) in late April and September. The summer biomass was 10-20 mg chlorophyll a/sq m. In the summer green algae dominated in the phytoplankton, but during the phytoplankton maxima diatoms prevailed. The chromatography indicated that the main features of the phytoplankton community structure are reflected in the pigment composition and it thus offers a rapid means of obtaining information on the physiological state of algae. The relative contribution of chlorophyll a to the total pigment extract was higher in rapidly increasing than in declining populations. The proportion of chlorophyll a was also higher in the dark season than in summer (40-50 and 25-35%, respectively). The carotenoids/chlorophyll a ratio increased from ca. 1 to 2.54 during the nutrient depletion and decline of biomass after the spring maximum in May. According to paper chromatography, phaeophytin a is much rarer in phytoplankton than is indicated by direct spectrophotometry after acidification. The other degradation products, such as chlorophyllides, which can be determined only by chromatography, were more common and abundant. (Author's abstract)
W88-10510

EVALUATION OF THE USE OF CATION-EXCHANGE RESIN FOR THE DETERMINATION OF ORGANICALLY-COMPLEXED AL IN NATURAL ACID WATERS,
Freshwater Biological Association, Ambleside (England).
C. A. Backes, and E. Tipping.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 30, No. 1/2, June 1987. 2 fig, 1 tab, 12 ref. European Economic Community Contract ENV.865.UK.

Descriptors: *Water analysis, *Chemical analysis, *Aluminum, *Acidic water, *Humic acids, Organically-complexed aluminum, Cation-exchange resin, Mathematical equations, Natural waters, Dialysis, Comparison studies.

The estimation of organically-complexed monomeric Al (Alorg) using the cation-exchange method developed by Driscoll was evaluated by comparison with equilibrium-dialysis measurements on solutions containing Al and isolated aquatic humic substances at pH 4-5.3. The cation-exchange method underestimates the concentration of Alorg by up to 25%, the extent of the discrepancy increasing with nu (mol Al bound/g humic substances). An empirical equation that allows the correction of the concentration of Alorg estimated by cation-exchange is given. (Author's abstract)
W88-10522

NOVEL IN SITU CASCADE ULTRAFILTRATION UNIT SPECIFICALLY DESIGNED FOR FIELD STUDIES OF ANOXIC WATERS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
R. R. De Vitre, F. Bujard, C. Bernard, and J. Buffle.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 31, No. 2-4, p 145-163, November 1987. 8 fig, 1 tab, 24 ref.

Descriptors: *Sample preservation, *Water analysis, *Dissolved oxygen, *Chemical analysis, *Ultrafiltration, Lakes, Particle size, Anoxic waters, Switzerland, Stratification, Hydrogen sulfide, Field tests, Carbon dioxide, Lake Bret, Hydrogen ion concentration, Lead, Iron, Manganese, Oxygen depletion.

The effect of sample handling and the experimental conditions used during a filtration experiment are critical factors which must be assessed if truly representative size distributions of natural particulates are to be obtained. This is particularly the case when colloidal sized, reactive (coagulation, oxidation, precipitation) species such as those found in anoxic lake waters are investigated. Such samples are generally rich in both H2S and CO2 and losses by volatilization may alter the pH and lead to changes in the species distribution between the dissolved, colloidal and particulate species. A submersible in situ cascade ultrafiltration unit which has been specifically developed to enable the study of particle size distributions in situ. This system has been used to investigate the particle size distributions of colloidal sized iron and manganese species in oxygen-depleted and totally anoxic-reduced water strata found in a well-stratified hypereutrophic lake (Lake Bret, Vaud, Switzerland). (Author's abstract)
W88-10534

PURGE AND TRAP GAS CHROMATOGRAPHIC METHOD FOR DIMETHYL SULFIDE IN FRESHWATER,
National Water Research Inst., Burlington (Ontario).
D. A. Holdway, and J. O. Nriagu.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 32, No. 3-4, p 177-186, February 1988. 2 fig, 5 tab, 15 ref.

Descriptors: *Acid rain sources, *Trace levels, *Chemical analysis, *Gas chromatography, *Surface water, *Dimethyl sulfide, Lakes, Performance evaluation, Statistics, Hamilton Harbors, Lake Ontario, Sulfides.

A simple purge and trap method is described for extracting trace levels (ng/l) of dimethyl sulfide (DMS) in freshwater samples. The DMS extracted is determined in a gas chromatograph equipped with a dual-flame photometric detector and a 2-m Chromosil 330 Teflon column. Good recoveries (93-105%) are achieved when diethyl sulfide is used as an internal standard. The standard error of the mean (for replicates) is about 5% at low (8-10 ng/l) DMS concentrations and about 3% at higher (90-130 ng/l) concentrations. The detection limit for the method is about 0.8 ng/l DMS. Water samples containing DMS should not be stored even at low temperatures for more than 6 hours, but once extracted, the DMS may be preserved in the gas sample vials for weeks. The method has been used in determining the natural levels of DMS in surface waters from Hamilton Harbor (Lake Ontario). The values found between April and July, 1986 typically varied from 40 to 770 ng/

l, and were much lower than the levels generally observed in the oceans. (Author's abstract)
W88-10545

NIOBIUM IN THE ENVIRONMENT AND A NEW METHOD FOR ITS TRACE ANALYSIS USING MOLECULAR OR ATOMIC ABSORPTION SPECTROMETRY,
Centre for Water Resources Development and Management, Calicut (India). Water Quality and Environment Div.
S. A. Abbasi.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 33, No. 1, p 43-57, February 1988. 2 fig, 6 tab, 22 ref.

Descriptors: *Chemical analysis, *Trace metals, *Bioaccumulation, *Cycling nutrients, *Niobium, Natural waters, Alloys, Ores, Atomic absorption spectrometry, Spectrophotometry.

The status of niobium in the environment is briefly reviewed, and a new method suitable for the trace analysis of the metal in ores, alloys, plant tissues, animal tissues, and natural waters is presented. The method is based on the selective extraction of niobium as its complex with N-p-methoxyphenyl-2-furylacrylohydroxamic acid (MFHA) in organic solvents. For molecular absorption spectrophotometric analysis chloroform is used in extraction and a ternary complex is formed in the extract by adding 4-(2-pyridylazo) resorcinol (PAR). The ternary complex has an absorbance maximum at 550 nm. Solvent extraction from the aqueous phase to lower volumes of organic phase enables up to 20-fold enrichment of niobium(V) and the method is capable of determining niobium levels down to 0.0001 ppm (0.1 ppb). For the atomic absorption spectrometric (AAS) determination, methyl isobutyl ketone is used as extracting solvent and a sensitivity of 0.3 ppm, which is over 3 times higher than attained so far with flame AAS, is achieved. Both the instrumental methods were applied to the environmental analysis of niobium and excellent agreement was observed. (Author's abstract)
W88-10550

FORECASTING THE STORM OF 15-16 OCTOBER 1987,
Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 2B.
W88-10565

GREAT STORM OF 15-16 OCTOBER 1987,
For primary bibliographic entry see Field 2B.
W88-10566

DRIVING RAIN - CALCULATIONS AND MEASUREMENTS FOR BUILDINGS,
Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 2B.
W88-10567

METHODS OF DETERMINING THE PARTICLE-SIZE DISTRIBUTION OF COARSE SOILS USED IN CONSTRUCTION,
For primary bibliographic entry see Field 8D.
W88-10584

NEUTRON MOISTURE METER CALIBRATION IN LARGE DIAMETER BOREHOLES,
Nevada Univ. System, Reno. Water Resources Center.
For primary bibliographic entry see Field 2G.
W88-10648

DESIGN FOR AN AUTOMATED TENSION INFILTROMETER,
Iowa State Univ., Ames. Dept. of Agronomy.
M. D. Ankeny, T. C. Kaspar, and R. Horton.
Soil Science Society of America Journal SSSJD4, Vol. 52, No. 3, p 893-896, May/June 1988. 4 fig, 6 ref.

Descriptors: *Soil water, *Infiltrometers, *Tensiometers, *Automation, *Measuring instruments, Macropores, Sorptivity, Hydraulic conductivity.

An automated tension infiltrometer useful for a range of water tensions from 0.02 to 0.50 m and for infiltration rates of 1 x 10 to the minus 8th power to 5 x 10 to the minus 4th power m/s is described. Infiltration rates are calculated from the change in water height in a Mariotte column. Water height is automatically measured by using the difference in tension between two pressure transducers, one installed at the top, and the other at the bottom, of the Mariotte column. Precision of water height measurement using two transducers (SD = 2.2 mm) is increased as compared with height measurements made with only one transducer (SD = 6.2 mm). With only one transducer, much of the measurement error is due to tension fluctuations or 'noise' caused by bubbling in the Mariotte column. The new design also incorporates several features used or suggested by other workers. A bubble tower is used for tension regulation, and interchangeable Mariotte columns of different diameters are used to match column volume with expected cumulative infiltration. Advantages of the new device include (i) quick and accurate tension control at low tensions, (ii) improved measurement precision at low flow rates, and (iii) automatic measurement and data collections, which increases measurement speed and eliminates bubbling-induced variability. (Author's abstract)
W88-10649

PUMP SAMPLER STUDY OF MICRODISTRIBUTION IN WALKER LAKE, ARIZONA, U.S.A.: A SENESCENT CRATER LAKE,
Northern Arizona Univ., Flagstaff. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-10652

DOES IONIC STRENGTH AFFECT THE CONFIGURATION OF AQUATIC HUMIC SUBSTANCES, AS INDICATED BY GEL FILTRATION,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, R. I. Jones, and K. Salonen.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 453-459, June 1987. 5 fig, 3 tab, 16 ref.

Descriptors: *Water analysis, *Lakes, *Ions, *Gel filtration, *Dialysis, *Humic substances, Finland, Chemical analysis, Surface water, Dissolved solids, Fulvic acids, Spectroscopy, Color, Molecular size.

The effect of ionic strength on the configuration of aquatic humic substances was studied by gel filtration and dialysis of water from small, Finnish forest lakes of varying color. Sephadex gel filtration of water from the most humic lake gave similar elution profiles of UV absorbance and dissolved organic carbon (DOC). Gel filtration of unconcentrated samples from all three lakes under natural conditions of ionic strength (I=1.7 x 10 to the (-4) power), and pH (5.5-6.0) gave similar fractionation on humic substances, despite their widely differing color and DOC. Increasing the ionic strength by two orders of magnitude caused considerable retardation on the Sephadex columns of the humic substances, suggesting a decrease in their molecular size and/or shape. Dialysis experiments strongly indicated that ionic strength-induced changes in the configuration of the aquatic humic substances are indeed real. It is probable that the elution behavior of aquatic humic substances on Sephadex gels has previously been wrongly attributed to ionic strength-dependent interactions between the gel and the humic substances. (Author's abstract)
W88-10661

INEXPENSIVE WATER CIRCULATION SYSTEM FOR STUDIES OF CHEMICAL EXCHANGE USING SEDIMENT CORES,
Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
B. Fowler, J. Drake, D. Hemenway, and S. I. Heaney.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 509-511, June 1987. 3 fig, 5 ref.

Descriptors: *Sediments, *Pumps, *Sediment-water interfaces, *Nutrients, Hydrogen ion concentration, Chemical analysis, Cores, Phosphorus, Silica, Flow rates, Flow velocity, Design criteria.

An inexpensive pumping and reservoir system was developed for circulating water over intact sediment cores. The system facilitates both measurement and manipulation of supernatant properties and flow velocities. The circulation system consists of the sediment core and overlying liquid, an adjustable head chamber, a reservoir chamber, and a pump. The apparatus has been used to evaluate the effect of flow velocity and pH on nutrient exchange (phosphorus, silica) at the sediment-water interface. (Stoehr-PTT)
W88-10662

RESPONSE OF ASTERIONELLA FORMOSA TO GERMANIUM: IMPLICATIONS FOR THE GERMANIUM-INHIBITION TECHNIQUE FOR ESTIMATING DIATOM CONTRIBUTION TO COMMUNITY PRODUCTIVITY,
Allegheny Coll., Meadville, PA. Dept. of Biology.
M. L. Ostrofsky, and A. E. Bellmer.
Freshwater Biology FWBLAB, Vol. 17, No. 3, p 547-552, June 1987. 1 fig, 2 tab, 13 ref.

Descriptors: *Germanium, *Diatoms, *Productivity, *Primary phytoplankton, *Asterionella formosa, In situ tests, Biomass, Inhibition, Photosynthesis, Carbon, Metabolism, Errors, Plant physiology.

The effect of added germanium on the assimilation of carbon by Asterionella formosa Hass. in mixed phytoplankton assemblages was measured weekly from July to December 1981 by autoradiography. Contrary to a major assumption of the germanium-inhibition method of partitioning primary productivity, the germanium-induced inhibition varied considerably and with no apparent pattern. Inhibition values determined for laboratory cultures are probably do not indicate the responses of in situ populations, and serious errors can occur in estimating diatom contribution to total community photosynthesis. This places severe limitations on the use of the method. (Author's abstract)
W88-10665

MACVUTI SAMPLER: A NEW AND INEXPENSIVE VOLUME SAMPLER FOR PLANKTON AND WATER,
Nairobi Univ. (Kenya). Dept. of Zoology.
M. Litterick, and K. M. Mavuti.
Freshwater Biology FWBLAB, Vol. 15, No. 4, p 465-467, August 1985. 1 fig.

Descriptors: *MacVuti sampler, *Sampling, Samplers, *Plankton, Zooplankton, Water sampling, Water analysis, Chemical analysis, Limnology.

Details are presented for the design and construction of a cheap simple volume sampler for zooplankton and water. The operation of this device is presented, and the ways of collecting various types of samples is described. (Author's abstract)
W88-10678

DETERMINATION OF BIOLOGICALLY AVAILABLE PHOSPHORUS USING A RADIOBIOASSAY TECHNIQUE,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
C. Jordan, and P. Dinsmore.
Freshwater Biology FWBLAB, Vol. 15, No. 5, p 597-603, October 1985. 2 fig, 1 tab, 22 ref.

Descriptors: *Limiting nutrients, *Radioactivity techniques, *Bioassay, *Water analysis, *Phosphorus, *Radiobioassay technique, Orthophosphates, Water sampling, Lakes, Ecology, Aquatic life, Algae, Northern Ireland, Chemical reactions, Kinetics, Selenastrum capricornutum, Chemical analysis.

A kinetic approach in which the uptake rate of simultaneous additions of orthophosphate and carrier-free phosphorus-32 by a standard culture of the green alga Selenastrum capricornutum under near neutral conditions was used to obtain an estimate of the readily available components of the

total phosphorus pool in natural freshwater samples. A comparision was made between the values of the biologically available phosphorus obtained using this radiobioassay technique and those obtained by the soluble reactive phosphorus procedure for 31 freshwater samples. Only about three-quarters of the phosphorus measured as soluble reactive phosphorus was readily available to algae. The results agreed with those obtained in an earlier study in which an enzymatic procedure was used to determine orthophosphate. The results of tests carried out on the water samples used in this study were consistent with the conclusion that the presence of a hydrous ferric oxide-orthophosphate complex in the samples caused the soluble reactive phosphorus value to be greater than the corresponding biologically available phosphorous value. (Author's abstract)
W88-10687

DISSOLVED OXYGEN BUDGET MODEL FOR LAKE ERIE IN SUMMER,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-10694

RESOURCE-MEDIATED DEMOGRAPHIC VARIATION DURING THE MIDSUMMER SUCCESSION OF A CLADOCERAN COMMUNITY,
Oklahoma Univ., Kingston. Biological Station.
For primary bibliographic entry see Field 2H.
W88-10715

SATELLITE DETECTION OF BLOOM AND PIGMENT DISTRIBUTIONS IN ESTUARIES,
National Oceanic and Atmospheric Administration, Washington, DC. Assessment and Information Services Center.
R. P. Stumpf, and M. A. Tyler.
Remote Sensing of Environment RSEEA7, Vol. 24, No. 3, p 385-404, April 1988. 11 fig, 1 tab, 27 ref. NSF Grants OCE-8109928 and OCE-8310407.

Descriptors: *Turbidity, *Satellite technology, *Remote sensing, *Eutrophication, *Estuaries, Vector analysis, Reflectance, Optical properties, Model studies, Pigments, Water color.

Using a form of vector analysis of satellite spectral data, it is possible to distinguish variations in water color and pigment concentrations from changes in turbidity. In turbid water (reflectance > 0.01), the orientation of a spectral vector depends predominantly on organic pigment absorption. Turbidity controls the total reflectance. A reflectance model based on the vector expression is discussed. This method apparently can identify blooms in estuaries where the reflectance is between 0.01 and 0.07 and, with some calibration, may provide estimates of chlorophyll for concentrations greater than 5 micrograms/l. The vector analysis method can be tested using data collected by two different sensors, the AVHRR (Advanced High Resolution Radiometer) and the CZCS (Coastal Zone Color Scanner). A simple uniform atmospheric correction to AVHRR and CZCS satellite data showed the location of blooms in the Chesapeake Bay in the springs of 1981 and 1982. (Brock-PTT)
W88-10725

COMPARISON OF CHLOROPHYLL A AND CAROTENOID CONCENTRATIONS AS INDICATORS OF ALGAL VOLUME,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
R. H. Foy.
Freshwater Biology FWBLAB, Vol. 17, No. 2, p 237-250, April 1987. 7 fig, 4 tab, 21 ref.

Descriptors: *Carotenoids, *Algae, *Chlorophyll a, *Biomass, *Spectrophotometry, Seasonal variation, Phytoplankton, Light quality, Oscillatoria, Nitrogen, Phosphorus, White Lough, Lough Neagh, Ireland, Limiting nutrients, Analytical methods, Lakes.

Carotenoid concentration, as measured by absorbance at 480 nm, was a better indicator of algal volume than chlorophyll a when the results from two lakes and laboratory studies on Oscillatoria agardhii var. isothrix Skuja were compared. The correlation between algal volume and carotenoid in White Lough was significantly higher than that between algal volume and chlorophyll a. The Lough Neagh correlation coefficient for algal volume with carotenoid was only marginally stronger than that with chlorophyll a. The relatively weak correlation between algal volume and chlorophyll a in White Lough was a result of a summer decline in the chlorophyll a content of O. agardhii var. isothrix, which dominated the phytoplankton. The chlorophyll a content of the phytoplankton was depressed by high summer daily totals of light hours received by the phytoplankton in White Lough of up to 14 h in comparison to a maximum value of 3.8 h in Lough Neagh, where no seasonal cycle of chlorophyll a content was evident. Laboratory studies demonstrated that while chlorophyll a per unit algal volume of O. agardhii var. isothrix declined with increasing light dose, carotenoid content did not. Nitrogen and phosphorus limitation depressed the carotenoid content but to a lesser degree than was observed for chlorophyll a. (Author's abstract)
W88-10727

SUBMERSIBLE NET-PUMP FOR QUANTITATIVE ZOOPLANKTON SAMPLING: COMPARISON WITH CONVENTIONAL NET SAMPLING,
F. Mohlenberg.
Ophelia OPHLAN, Vol. 27, No. 2, p 101-110, May 1987. 4 fig, 2 tab, 16 ref.

Descriptors: *Sampling, *Plankton nets, *Submersible net-pump, *Zooplankton, *Sampling devices, Measuring instruments, Analytical methods, Aquatic animals, Biomass.

A new sampling system for quantitative zooplankton studies is described. It consists of a centrifugal pump and a plankton net combined in a single submersible unit. The performance of the net-pump was compared to vertical hauls with a 100-micron WP-2 net on two occasions characterized by large differences in zooplankton biomass. The filtration efficiency of the WP-2 net decreased steadily, due to clogging, from ca. 100% at the onset of sampling (25 m) to about 50% at the surface. Clogging in the net-pump was not observed even after prolonged sampling. In vertical hauls, the capacity of the net-pump (420 L/min) was sufficient to catch even adult Calanus finmarchicus quantitatively. Used in the stationary mode at fixed depths, most adult C. finmarchicus escaped from the pump intake. The volume filtered by the net-pump was only a fraction of the volume filtered by the WP-2 net. However, the total variation (variation among samples + subsample error) was identical (May) or markedly lower (October) for pump samples. The appendicularian Oikopleura dioica was probably damaged beyond recognition in the net-pump judging from the very low numbers recorded in the pump samples. For all other taxa, the damage caused by the pump did not interfere with identification. (Author's abstract)
W88-10757

RECOMMENDATIONS FOR WATER QUALITY INVESTIGATION OF DRINKING WATER SUPPLY RESERVOIRS IN CZECHOSLOVAKIA,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 5B.
W88-10805

DETERMINATION OF THE ORTHOPHOSPHATE AND TOTAL ORTHOPHOSPHATE, SENSITIVITY AND REPRODUCIBILITY,
Institut Hygieny a Epidemiologie, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5A.
W88-10811

GAS CHROMATOGRAPHIC/MASS SPECTROMETRIC IDENTIFICATION OF CHLORINATED AND OXYGENATED CYCLOHEXENE ARTIFACTS FORMED DURING THE ANALYSIS OF CHLORINATED WATER SAMPLES,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W88-10838

EVALUATION OF A HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY METHOD FOR THE DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN SOIL AND WATER,
Midwest Research Inst., Kansas City, MO.
For primary bibliographic entry see Field 5A.
W88-10839

DISCHARGE-TIME METHOD. A NEW TECHNIQUE FOR SAMPLING PLANKTON IN FLUVIAL SYSTEMS, WITH A NOTE ON THE MODIFIED PLANKTON SAMPLING DEVICE,
Garhwal Univ., Srinagar (India). Dept. of Zoology.
P. Nautiyal, A. S. Saklani, and H. R. Singh.
Proceedings of the Indian Academy of Sciences (Animal Science), Vol. 95, No. 6, p 751-756, December 1986. 2 fig, 1 tab, 6 ref.

Descriptors: *Plankton nets, *Sampling, *On-site data acquisition, Biomass, Rivers, Torreutial streams, Statistics, Performance evaluation.

A technique to sample plankton efficiently in the fluvial systems is described along with a discussion of the need for and design of the plankton sampling device suited to torrential reaches. The technique, named as discharge-time method, has certain advantages. The requirements are minimum (detachable bucket of the conical plankton net with bolting silk cloth of required mesh size) and the efforts are nominal. To sample plankton, the device has to be dipped into the river with its open end facing the current, for a pre-calculated period of time. The formula, 't' seconds = x/4v (where x = the volume of water to be sampled in liters and v = the discharge in liters/sec) was computed to calculate the time for which the device should remain submerged. Large volumes of water can be filtered within seconds. The validity of this method has been assessed by employing 't' tests. (Author's abstract)
W88-10857

USE OF A MULTIGRID TECHNIQUE TO STUDY EFFECTS OF LIMITED SAMPLING OF HETEROGENEITY ON TRANSPORT PREDICTION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-10931

HARMONIZATION OF BIOLOGICAL TESTING METHODOLOGY: A PERFORMANCE-BASED APPROACH,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11013

COMPARISON OF TECHNIQUES FOR EVALUATING THE EFFECT OF CADMIUM ON PSEUDOMAS FLUORESCENS,
Toronto Univ. (Ontario). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W88-11015

MEASURING FISH LENGTHS FROM INSTANT PHOTOGRAPHS USING A DIGITIZING TABLET AND MINICOMPUTER,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
S. Sauter, and J. L. Harrison.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky,

April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 321-327, 1 fig, 1 tab, 19 ref.

Descriptors: *Data acquisition, *Fish length, *Photography, *Computers, *Digitization, Fish, Computer programs, Statistical studies.

A modification of photographic techniques for measurement of fish lengths has been developed, which uses instant photography and a digitizing tablet with a mini-computer. Instant photography allows print inspection while live fish are retained and 'retakes' of poor quality photographs can be made. A photographic record of test animals is obtained, and fish may then be measured from the photographs at any convenient time. The digitizing tablet decreases time for fish measurement from photographs and maintains or improves accuracy over manual techniques. Raw data are entered directly into the minicomputer, which is programmed to perform summary statistics after all groups are measured. Summary statistics and raw data are printed to a prescribed format by the computer. The elimination of manual data entry and subsequent data validation will result in a substantial savings in time. (See also W88-10991) (Author's abstract)
W88-11016

USEFULNESS OF THE LIPID INDEX FOR BIOACCUMULATION STUDIES WITH DAPHNIA MAGNA,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W88-11019

RAPID AQUATIC TOXICITY ASSAY USING INCORPORATION OF TRITIATED-THYMIDINE INTO SEA URCHIN, ARBACIA PUNCTULATA, EMBRYO: EVALUATION OF TOXICANT EXPOSURE PROCEDURES,
JRB Associates, Inc., Narragansett, RI. Marine Services Branch.
For primary bibliographic entry see Field 5C.
W88-11022

DATA BASE DESIGN FOR A REGIONAL GROUND WATER QUANTITY ASSESSMENT IN KANKAKEE AND NORTHERN IROQUOIS COUNTIES, ILLINOIS,
Illinois State Water Survey, Champaign. Ground-Water Section.
For primary bibliographic entry see Field 4B.
W88-11036

ESTIMATING IRRIGATION PUMPAGE: LESSONS IN THE VARIABILITY OF INDIVIDUAL WELL PUMPAGE,
Illinois State Water Survey, Champaign. Ground-Water Section.
J. A. Bowman, and S. D. Wilson.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 81-91, 4 fig, 4 tab, 19 ref.

Descriptors: *Groundwater management, *Irrigation, *Pumpage, *Wells, *Estimating, *Variability, Illinois, Comparison studies, Sensors, Model studies, Consumptive use, Hydrologic budget, Prediction.

Three methods of estimating irrigation pumpage were compared to metered values for one growing season in an intensively-irrigated region in central Illinois. The purpose was, first, to test the suitability of a vibration sensor for indicating well pumpage and, second, to evaluate two generalized water-use models for their ability to predict average and specific irrigation-well pumpage. The vibration sensor performed poorly, particularly on an individual-well basis. The two water-use models, a crop-consumptive-use model and a water-budget model, performed only slightly better than the vibration sensor on an individual-well basis. However, the water-budget model appears to be a relatively good indicator of seasonally-averaged metered pumpage. A much larger degree of variance existed among the metered values than was expected for largely homogeneous soil, crop, and weather conditions. This points to the need for a long-term period of metered records with on-site meteorological observation and more-frequent meter readings in order to improve confidence in the relationship between metered pumpage and the water-budget model results. (See also W88-11031) (Author's abstract)
W88-11037

USE OF FACIES MODELS AS PREDICTIVE TOOLS TO LOCATE AND CHARACTERIZE AQUIFERS IN GLACIAL TERRAINS,
Indiana Geological Survey, Bloomington.
For primary bibliographic entry see Field 2F.
W88-11040

ELECTRICAL RESISTIVITY APPLICATIONS TO GLACIAL AND GROUNDWATER SITE EVALUATIONS IN EAST-CENTRAL INDIANA,
Ball State Univ., Muncie, IN.
A. C. Samuelson.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 207-229, 12 fig, 1 tab, 25 ref.

Descriptors: *Geophysics, *Data acquisition, *Groundwater, *Measuring instruments, *Resistivity, *Glacial drift, Groundwater mining, On-site investigations, Evaluation, Indiana, Fences, Drainage, Elevation, Precipitation, Soil surveys, Sounding, Soil profiles, Water table profiles, Computer models, Case studies.

Electrical resistivity methods have been used for research, consulting, and instructional projects, but it is difficult to obtain consistent realistic results from site to site. Successful projects require consideration of many often-overlooked items. Investigators should always spend considerable time noting the site characteristics, such as fence and drainage lines, elevation changes, recent precipitation data, and soils map information. Baselines should be established which can be repeated if data will be taken at different seasons of the year. A sounding line should be run first to determine the nature of contrasts and suitable electrode spacings for profiling. It might not be the final sounding; others may be more desirable after locating contrasting areas by profiling. Computer curve modeling will be useful for consistency but, to properly use, interpret, and interact with the computer trials, past experience with hands-on curve matching is also required. Case histories presented include several studies which involved delineating glacial horizons, bedrock depths, groundwater levels, and contaminant plumes. (See also W88-11031) (Author's abstract)
W88-11044

ESTIMATING FRACTURE CONNECTIVITY USING MEASUREMENTS OF BOREHOLE TEMPERATURES DURING PUMPING,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W88-11045

INVESTIGATING SUBSURFACE FUEL RELEASES USING AMBIENT TEMPERATURE HEADSPACE ANALYSIS,
ERT, Fort Collins, CO.
For primary bibliographic entry see Field 7A.
W88-11046

COMBINED EXPLORATION TECHNIQUES FOR FRACTURED TILL AND LOESS,
GeoEngineering, Inc., Denville, NJ.
C. R. Butts, and W. H. McTigue.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 267-271.

Descriptors: *Soil surveys, *Permeability, *Fracture permeability, *Glacial soils, *Loess, *Core drilling, Cross-sections, Exploration, On-site investigations, Pumping tests, Hydraulic properties, Costs, Trenches, Soil water.

Low-permeability soils, such as loess and till, preclude classical pumping tests as a technique for estimating bulk in-situ hydraulic properties. Hence, small-scale laboratory permeability tests are substituted and the bulk characteristics of the deposit are extrapolated from the laboratory results. However, the experience of the writers has shown that the in-situ bulk hydraulic properties, especially permeability, sometimes are not the same as those determined in the laboratory. Two exploration techniques have been found useful in overcoming this problem without substantial increase in cost of subsurface exploration programs. The first is backhoe-excavated test pits or trenches located so as to expose large subsurface cross-sections for close examination, sampling, and photography. The second is the use of a continuous soil coring device, in conjunction with hollow-stem auger drilling, permitting truly continuous five-foot increments of soil 'core' to be examined in the field or laboratory and reducing the unobserved interval between samples to a minimum. (See also W88-11031) (Shidler-PTT)
W88-11047

SOIL GAS INVESTIGATIONS FOR VOLATILE SUBSURFACE CONTAMINANTS: CASE STUDIES IN KANSAS, USA,
Tracer Research Corp., Tucson, AZ.
T. A. Runyon, and G. M. Thompson.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 275-282, 2 fig, 2 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Soil gases, *Pollutants, Case studies, Kansas, Remote sensing, Volatile organic compounds, Surface-groundwater relations, Aeration zone, Diffusion, Water pollution sources, Plumes, Chlorinated hydrocarbons, Cost analysis, Trichloroethene, Carbon tetrachloride.

A remote-detection technique for the tracing of groundwater contamination by volatile organic compounds (VOCs) has been developed. The technique involves sampling and analyzing soil gas contained in the vadose zone for the presence of VOCs. Contaminated groundwater acts as a source of VOCs and a chemical concentration gradient is established between the source and the atmosphere resulting in the vertical diffusion of contaminants through the vadose zone. Organic compounds with low aqueous solubilities and high vapor pressures are most amenable to soil-gas analysis. This technique was used to assess the chemistry, source location, migration direction, and areal extent of groundwater contamination by trichloroethene (TCE) at two separate sites in Kansas. At the southeastern Kansas site, a TCE contamination plume was mapped in the soil gas from a possible source area to contaminated supply wells. A second area of VOC contamination was identified in the immediate vicinity of a solvent storage area. In south-central Kansas, carbon tetrachloride contamination emanating from a grain elevator was detected in the soil gas. Contamination, as defined by soil-gas analysis, extended 3400 feet south of the grain elevator. The data obtained from a soil-gas investigation can be used prior to conventional methods of investigation as a cost-effective means of assessing distribution of VOCs in the groundwater. (See also W88-11031) (Author's abstract)
W88-11048

TWO-DIMENSIONAL GROUND WATER FLOW MODEL OF THE DOWNTOWN INDIANAPOLIS AREA,
Indiana State Dept. of Natural Resources, Indianapolis.
For primary bibliographic entry see Field 2F.
W88-11052

UNIFIED GROUND WATER MONITORING PROGRAM,

Waste Management of North America, Southfield, MI. Northwest Regional Office.
For primary bibliographic entry see Field 7A.
W88-11054

MIDWESTERN MONITORING WELL INSTALLATION AND DEVELOPMENT,
Geotechnology, Inc., St. Louis, MO.
For primary bibliographic entry see Field 7A.
W88-11055

EFFECT OF CONSTRUCTION, INSTALLATION, AND DEVELOPMENT ON THE TURBIDITY OF WATER IN MONITORING WELLS IN FINE-GRAINED GLACIAL TILL,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
For primary bibliographic entry see Field 5A.
W88-11056

INSTALLATION OF OBSERVATION WELLS: THE HIDDEN COSTS,
Groundwater Technology, Inc., North Ridgeville, OH.
For primary bibliographic entry see Field 7A.
W88-11057

INITIAL RESPONSE TO A GROUND WATER CONTAMINATION PROBLEM, HANCOCK COUNTY, INDIANA,
Indiana Dept. of Environmental Management, Indianapolis.
For primary bibliographic entry see Field 5G.
W88-11059

LABORATORY AND FIELD EVALUATION TECHNIQUES TO DETERMINE WASTE/AQUIFER COMPATIBILITY IN UNDERGROUND INJECTION SYSTEMS,
Davis (Ken E.) Associates, Houston, TX.
For primary bibliographic entry see Field 5E.
W88-11064

APPLICATION OF THE TEMPERATURE SURVEY IN DEMONSTRATING THE MECHANICAL INTEGRITY OF INJECTION WELLS,
Davis (Ken E.) Associates, South Bend, IN.
M. D. Jarrell, and R. Lyle.
IN: Proceedings of the NWWA FOCUS Conference on Midwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 569-590, 12 fig, 4 ref.

Descriptors: *Water quality, *Underground waste disposal, *Well casings, *Groundwater, *Well Logs, *Water temperature, *Mechanical failure, *Injection wells, Fluid flow, Well seepage, Well regulations, Guidelines, Case studies, Midwest, Nevada, Measuring instruments.

The temperature log has an important role in demonstrating the absence of fluid migration behind the casing in injection wells. At the present time, many regulatory agencies require temperature logs to satisfy the mechanical-integrity test requirements of the Underground Injection Control program. However, these agencies have not established guidelines for conducting a temperature survey. Two methods have been successfully applied and approved by regulatory agencies in specific cases. The first method involves an injecting temperature log and a series of shut-in logs run immediately after normal injection is ceased. The second method requires a stabilized static base log followed by a period of injection and a subsequent suite of post-injection temperature logs. As these logs have become more prevalent in mechanical-integrity evaluations, experience shows that the three critical survey parameters are the shut-in time prior to the static base log, the volume of water injected, and the temperature differential between the injected water and the formation water in the zone of interest. Recommended procedures for running and presenting temperature logs have been developed based on case histories of both Class I and Class II injection wells in the Midwest and Nevada. These cases include logs conducted in wells with and without tubing, and utilize both traditional differential-temperature tools and the newer radial differential-temperature tool. (See also W88-11031) (Author's abstract)
W88-11065

RANDOM SAMPLE SURVEY FOR PESTICIDES: FLORIDA EXPERIENCE,
Florida State Dept. of Agriculture and Consumer Services, Tallahassee.
A. N. Shahane, and R. C. Inman.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 108-121, 1 fig, 6 tab, 10 ref.

Descriptors: *Florida, *Pesticides, *Data collections, *Surveys, Planning, Water quality control, Monitoring, Groundwater pollution.

The Florida Department of Agriculture and Consumer Services has conducted three annual random sample surveys, as authorized by the Florida Pesticide Law and Regulations. Random sample surveys collect pesticide use data from licensed applicators who are required to keep records of Restricted Use Pesticides for two years. Randomly selected applicators are requested to submit data on a survey form designed for computer input and are asked to include types and quantities of restricted use pesticides, methods of application, crops treated, and dates and locations of application. Results of these surveys have been used in the pesticide assessment procedure for selective pesticide monitoring of groundwater in Florida. Florida's experiences with the random sample survey is presented and an attempt is made to provide a tool for collecting pesticide use information at the state level. The problems with using dealer sales information to establish pesticide use patterns are illustrated. A methodology of random sample survey and recent efforts made by state agencies to refine the survey are included. (See also W88-11084) (Miller-PTT)
W88-11093

SURFACE GEOPHYSICAL STUDY OF A BORROW PIT LAKE,
Seaburn and Robertson, Inc., Tampa, FL.
R. J. Windschauer.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 295-303, 6 fig.

Descriptors: *Artificial lakes, *Clays, *Leakage, *Magnetic studies, Electromagnetic waves, Resistivity, Direct current resistivity, Electromagnetic methods, Water loss, Permeability Geophysics.

A surface geophysical survey was completed to determine the presence and depth of clay for the owners of a residential development constructing a series of interconnected ponds. The survey included direct current resistivity and electromagnetic methods. The depth of an already existing lake on the site made conventional electromagnetic methods impossible. The electromagnetic survey was completed by floating the configuration across the lakes on several rafts with the transmitting and receiving coil fastened in the horizontal dipole mode and separated by PVC pipe. A 1400 foot length of 0.5 inch nylon rope marked off in 50 foot increments was used to move the configuration across the lake while taking readings. Where no lake existed, the electromagnetic survey was completed by conventional methods. The electromagnetic survey was effective in determining the presence of clay throughout the site and an estimate of clay thickness was made through calibration of electromagnetic measurements. The geophysical survey provided a cost effective means for obtaining subsurface information where a large part of an area is submerged. (See also W88-11084) (Miller-PTT)
W88-11104

USE OF LIMITED GEOPHYSICAL LOG DATA TO DELINEATE AND CHARACTERIZE DISPOSAL AND CONFINING ZONES,
Davis (Ken E.) Associates, Baton Rouge, LA.
For primary bibliographic entry see Field 5E.
W88-11105

AUDITING EXISTING MONITOR WELLS,
Technos, Inc., Miami, FL.
For primary bibliographic entry see Field 5A.
W88-11106

USE OF GEOPHYSICAL LOGS IN CONJUNCTION WITH CONCENTRATED ACID INJECTION TO IMPROVE WATER YIELDS FROM LIMESTONE WELLS IN TAMPA, FLORIDA,
CH2M Hill Southeast, Inc., Tampa, FL.
For primary bibliographic entry see Field 3B.
W88-11109

TERRAIN CONDUCTIVITY AS A TOOL FOR DELINEATING HYDROCARBON PLUMES IN A SHALLOW AQUIFER -- A CASE STUDY,
Woodward-Clyde Consultants, Tallahassee, FL.
R. M. Valentine, and T. Kwader.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 405-416, 3 fig, 1 tab.

Descriptors: *Geophysics, *Path of pollutants, *Groundwater pollution, *Hydrocarbons, *Chemical wastes, *Conductivity, Terrain conductivity, Subsurface water, Aquifers, Case studies.

Under favorable site conditions, terrain conductivity has proven to be an effective tool for assessing the areal extent and relative concentrations of contaminants having a significant conductivity contrast with the native groundwater. In late 1983, a hydrocarbon residue was observed and collected at the water table on the bank of a drainage canal adjacent to a small chemical mixing plant. Although the contaminant was identified as a non-hazardous hydrocarbon belonging to the chemical facility, its exact source was unknown. A shallow terrain conductivity survey was conducted to aid in locating the source(s) of contamination. Approximately 6 acres were surveyed on a 20 by 20 foot grid. Six anomalous areas of apparent low conductivity (< 0.25 millimhos) were delineated. Two of the analomous areas were located away from the active facility and were later identified as old dump sites. A third low conductivity area adjacent to the storage/mixing facility indicated that a plume might be migrating towards the property boundary. Borings were located largely from analysis of the results of the conductivity survey and confirmed the areal extent and concentration of the contaminants. The terrain conductivity survey proved to be a quick and cost-effective method for locating hydrocarbons in the shallow subsurface. The survey results provided a basis to formulate a drilling and sampling program, provided relative levels of contaminant concentration, and outlined areas in which to concentrate initial remedial measures. (See also W88-11084) (Author's abstract)
W88-11111

PROBLEMS IN THE INTERPRETATION OF SLUG TEST DATA FROM FINE-GRAINED GLACIAL TILLS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
C. D. Palmer, and D. G. Paul.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 99-123. 10 fig, 1 tab, 23 ref.

Descriptors: *Aqufier characteristics, *Aquifer testing, *Slug test data, *Glacial drift, *Hydraulic conductivity, *Data interpretation, Mathematical studies, Error analysis, Groundwater management, Soil texture, Test wells, Field tests, Permeability, Boundary conditions, Waste disposal.

Concerns about ground-water protection and waste management have prompted an interest in using slug tests to determine the hydraulic proper-

ties of fine-grained materials such as glacial tills. While slug tests offer a readily available method for the determination of the hydraulic properties of fine-grained materials, there are problems with conducting the tests and interpreting the results. A combination of field tests and mathematical studies suggest that both positive and negative biases of the formation properties can be obtained. The magnitude of errors that result from the application of analytical techniques that contain incorrect assumptions about the well configuration or boundary conditions that are inappropriate to testing in fine-grained materials are shown. While some problems can be overcome by altering the method for conducting the test or for interpreting the data, other problems may require new methodologies before their effects can be quantified. (See also W88-11121) (Author's abstract)
W88-11127

APPLICATION OF REMOTE DATA ACQUISITION SYSTEMS IN ASSESSING GROUND WATER FLOW DIRECTIONS,
Hart Crowser, Inc., Seattle, WA.
J. W. Massmann, and D. T. Matlock.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 299-312. 6 fig.

Descriptors: *Data acquisition, *Remote sensing, *Groundwater movement, *Data collections, *Data storage and retrieval, Computers, Monitoring wells, Water level fluctuations, Groundwater level, Cost analysis.

Remote data acquisition systems have recently been developed to obtain continuous measurements of water levels so that net ground water flow directions can be estimated for flow systems with time-varying boundary conditions. These state-of-the-art systems are now commercially available and are cost-effective in many instances. The application of these data acquisition systems is described in this paper. Included in the paper are discussions related to (1) system components, (2) installation procedures, (3) data reduction procedures, and (4) typical costs. The use of personal computers to recover and reduce data collected by the acquisition systems is also discussed. A case history is presented to illustrate the capabilities of the data acquisition systems. Water levels were measured in the Columbia River and in nearby ground water monitoring wells to determine net ground water flow directions. The water levels fluctuated in response to changes in the river stage, tides, ground water pumping wells, and precipitation. Without the data acquisition system, these fluctuations would have made it very difficult to determine net flow directions. (See also W88-11121) (Author's abstract)
W88-11136

PERCHED WATER IDENTIFICATION WITH RADIATION LOGS,
Washington State Univ., Pullman.
For primary bibliographic entry see Field 2F.
W88-11137

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART I. CONCEPTUALIZATIONS,
Oregon Graduate Center, Beaverton.
J. F. Keely, and K. Boateng.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 443-471. 8 fig, 3 tab, 18 ref.

Descriptors: *Monitoring wells, *Groundwater, *Groundwater pollution, *Drilling, *Water sampling, Contamination, Well casings, Boreholes, Monitoring, Well filters.

In this paper, commonly employed techniques for the installation, purging, and sampling of monitoring wells are examined. The degree to which hollow-stem augering disturbs the near-borehole environment, and how this may result in the movement of contaminated solids or fluids from one stratum to another is discussed. The desirability of driving temporary casing to shield one strata from another, and to improve the general quality of the monitoring well installation (especially the effectiveness of the filter pack emplaced), is argued. Due to limited data, further testing of sampling devices is needed. (See also W88-11121) (Author's abstract)
W88-11144

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES: PART II. CASE HISTORIES,
Oregon Graduate Center, Beaverton.
J. F. Keely, and K. Boateng.
IN: Proceedings of the NWWA FOCUS Conference on Northwestern Ground Water Issues. National Water Well Association, Dublin, OH. 1987. p 473-499. 12 fig, 2 tab, 14 ref.

Descriptors: *Monitoring wells, *Groundwater, *Groundwater pollution, *Drilling, *Water sampling, *Case histories, Cable tool drilling, Rotary drilling, Contamination, Well casings, Boreholes, Monitoring.

Three case histories are presented to illustrate the problems encountered using some monitoring well installation, purging, and sampling techniques. Hollow-stem augering, cable tool drilling, and drilling with the air rotary method were examined. A hybrid drilling technique, augering with temporary casing, was able to provide the advantages, and minimize the disadvantages, of the foregoing drilling methods. The potential movement of a contaminant plume can be identified by detailed aquifer tests using clusters of monitoring wells. Obtaining reliable data from such tests depended greatly on the ability of each monitoring well to act as a high quality hydraulic observation well. The selection of drilling and installation techniques that ensured minimal disturbance of the near borehole environment provided the best guarantee of such performance. (See also W88-11121) (Author's abstract)
W88-11145

CHEMICAL TRACERS OF POLLUTION PLUMES FROM SEPTIC SYSTEMS RECEIVING TWO TYPES OF DETERGENTS,
Wisconsin Univ.-Madison. Water Chemistry Program.
For primary bibliographic entry see Field 5B.
W88-11148

QUALITY ASSURANCE FOR ENVIRONMENTAL MEASUREMENTS.
For primary bibliographic entry see Field 7C.
W88-11158

WHAT IS QUALITY ASSURANCE,
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
For primary bibliographic entry see Field 7C.
W88-11159

U.S. ENVIRONMENTAL PROTECTION AGENCY'S QUALITY ASSURANCE PROGRAM,
Environmental Protection Agency, Washington, DC. Quality Assurance Management Staff.
For primary bibliographic entry see Field 7C.
W88-11160

DETERMINATION OF MEASUREMENT DATA QUALITY AND ESTABLISHMENT OF ACHIEVABLE GOALS FOR ENVIRONMENTAL MEASUREMENTS,
Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.
For primary bibliographic entry see Field 7C.
W88-11162

DISCHARGE MONITORING REPORT QUALITY ASSURANCE RESULTS AND FOLLOW-UP BY REGION VIII U.S. ENVIRONMENTAL PROTECTION AGENCY,
Environmental Protection Agency, Denver, CO. Region VIII.
For primary bibliographic entry see Field 7C.
W88-11173

NEW BIOLOGICAL REFERENCE MATERIALS - IN VIVO INCORPORATED TOXIC METALS IN WATER HYACINTH TISSUES,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11175

USE OF NATURAL WATERS AS U.S. GEOLOGICAL SURVEY REFERENCE SAMPLES,
Geological Survey, Denver, CO.
V. J. Janzer.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 319-333, 2 tab, 11 ref.

Descriptors: *Pollutant identification, *Data acquistion, *Quality control, *Water sampling, *Water analysis, *Sampling, Water quality, Administrative agencies, Trace metals, Nutrients, Herbicides, Pesticides, Insecticides, Chemical analysis.

The U.S. Geological Survey conducts research and collects hydrologic data relating to the Nation's water resources. Two water quality laboratories in Atlanta, Georgia, and Denver, Colorado, support the national research programs, and provide chemical analyses of natural waters for the data program. Additional chemical water quality data are provided by cooperator and contract laboratories. Continuous quality assurance efforts with these laboratories require several thousand reference samples each year. Reference samples approximating actual field samples provide the most realistic quality assurance for the laboratories. Seven types of natural matrix reference water samples are prepared for use in the Survey's quality assurance program. These include samples containing major constituents, trace metals, nutrients, herbicides, insecticides, trace metals in a water and suspended-sediment mixture, and precipitation (snowmelt). To prepare these reference samples, natural water is collected in plastic drums and the sediment is allowed to settle. The water is then filtered, selected constituents are added, and if necessary the water is acidified and sterilized by ultraviolet irradiation before bottling in plastic or glass. More than 1000 1-L samples of a given type may be prepared at a time. These reference samples are distributed twice yearly to more than 100 laboratories for chemical analysis. The most probable values for each constituent are determined by evaluating the data submitted by the laboratories using statistical techniques recommended by ASTM. A stockpile of several thousand reference samples is maintained by the preparation of new samples as needed. Periodically, some of these samples are submitted to laboratories as 'unknowns.' When the analytical data for these samples are reported and evaluated, problem areas detected are promptly reported to the respective laboratory. Use of both identified and unidentified reference samples provides some of the quality assurance data necessary to ensure the continuing accuracy of chemical analyses obtained to support the Survey's basic water-data collection and research program activities. (See also W88-11158) (Author's abstract)
W88-11176

ROLE OF NBS STANDARD REFERENCE MATERIALS IN QUALITY ASSURANCE OF ENVIRONMENTAL MEASUREMENTS,
National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.
For primary bibliographic entry see Field 7C.
W88-11177

REFERENCE MATERIALS AND INTERCOMPARISON SAMPLES AVAILABLE FROM THE

ENVIRONMENTAL MONITORING SYSTEMS LABORATORY - LAS VEGAS,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11178

REFERENCE SAMPLES FOR WATER-RELATED PROGRAMS IN THE U.S. ENVIRONMENTAL PROTECTION AGENCY,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Quality Assurance Branch.
For primary bibliographic entry see Field 5A.
W88-11179

ESTABLISHING AN ENVIRONMENTAL QUALITY ASSURANCE PROGRAM,
Utah Univ. Research Inst., Salt Lake City. UBTL Div.
For primary bibliographic entry see Field 7C.
W88-11180

INTERLABORATORY QUALITY ASSURANCE ASPECTS OF THE INTERNATIONAL JOINT COMMISSION'S GREAT LAKES MONITORING PROGRAMS,
National Water Research Inst., Burlington (Ontario). Quality Assurance and Methods Section.
For primary bibliographic entry see Field 7C.
W88-11181

USE OF DRIVEN CASING TO SAMPLE MULTIPLE SHALLOW WATER-BEARING ZONES IN THE GULF COAST,
Davis (Ken E.) Associates, Baton Rouge, LA.
For primary bibliographic entry see Field 5A.
W88-11192

TECHNIQUE USED TO DRILL MONITORING WELLS AT A HAZARDOUS WASTE SITE,
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 5A.
W88-11193

INSTALLATION OF OBSERVATION WELLS ON HAZARDOUS-WASTE SITES IN KANSAS USING A HOLLOW-STEM AUGER,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5A.
W88-11194

ASSESSMENT OF INFLUENCE OF COMPLEX HYDROGEOLOGIC AND GEOCHEMICAL CONDITIONS ON RCRA GROUND WATER MONITORING RESULTS,
IT Corp., Houston, TX.
For primary bibliographic entry see Field 5A.
W88-11195

HYDROGEOLOGIST AND DATA ACQUISITION FOR AQUIFER MODELING: QUO VADIS,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 2F.
W88-11203

CASE STUDIES IN WATER SUPPLY DEVELOPMENT BY GEOTHERMETRY TECHNIQUE,
For primary bibliographic entry see Field 2F.
W88-11212

NEW APPROACHES TO THE EVALUATION OF LEAK DETECTION MONITORS FOR UNDERGROUND STORAGE TANKS,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11214

DEVELOPMENT AND VALIDATION OF THE UNDERGROUND LEAK TRANSPORT ASSESSMENT MODEL (ULTRA),
Environmental Science and Engineering, Inc., Gainesville, FL.
W. A . Tucker, C. T. Huang, J. M. Bral, and R. E. Dickinson.
IN: Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration. Houston, Texas. November 12-14, 1986. National Water Well Association, Dublin, OH. 1986. p 53-77, 6 fig, 3 tab, 19 ref.

Descriptors: *ULTRA model, *Hydrologic models, *Model studies, *Groundwater pollution, *Path of pollutants, Risks, Data acquistion, Data interpretation, Leaching, Adsorption, Biodegradation, Soil properties, Dispersion, Hydrocarbons, Wells, Florida, SUTRA model, SESOIL model, Oil pollution.

This paper describes the Underground Leak Transport Assessment (ULTRA) model, developed by Environmental Science and Engineering, Inc. (ESE), as a tool for risk assessment and remedial alternative evaluations in the fate and transport of contaminants in unsaturated soils and groundwater. To develop this model, ESE reviewed the characteristics of Florida ground water systems that are vulnerable to petroleum contamination, Florida's soil characteristics, and spill characteristics of more than 50 documented leaks. The model was designed to be generally applicable for the State of Florida. The model, which fully couples the soil and aquifer zones, simulates adsorption, volatilization, and biodegradation in soil and aquifer systems; leaching of residual hydrocarbon from the soil column; and transport and dispersion by flowing ground water and recovery wells. ULTRA represents a merging of two widely tested models for soil and aquifer zones: the Seasonal Soil Zone Model (SESOIL), developed by the U.S. Environmental Protection Agency (EPA), and the Saturated/Unsaturated Transport Model (SUTRA), developed by the U.S. Geological Survey (USGS), respectively. Both models were modified for this application. The model accounts for residual hydrocarbon left in the soil column after free-floating product is removed. (See also W88-11213) (Author's abstract)
W88-11217

DEVELOPMENT AND EXPERIMENTAL VERIFICATION OF A MODEL FOR TRANSPORT OF CONCENTRATED ORGANICS IN THE UNSATURATED ZONE,
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W88-11220

MODELING MULTIPHASE CONTAMINANT TRANSPORT IN GROUND WATER AND VADOSE ZONES,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5B.
W88-11225

SIMULATION OF THE MOVEMENT OF VOLATILE ORGANIC VAPOR THROUGH THE UNSATURATED ZONE AS IT PERTAINS TO SOIL-GAS SURVEYS,
Hydrosystems, Inc., Falls Church, VA.
For primary bibliographic entry see Field 5B.
W88-11226

DIRECT DETECTION OF HYDROCARBON AND ORGANIC CHEMICALS WITH GROUND PENETRATING RADAR AND COMPLEX RESISTIVITY,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5A.
W88-11231

STATISTICAL REVIEW OF GROUND WATER DATA FROM WASTE DISPOSAL SITES,
Browing-Ferris Industries, Houston, TX.
For primary bibliographic entry see Field 5A.
W88-11232

STRATEGY FOR DETECTING SUBSURFACE ORGANIC CONTAMINANTS,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W88-11235

EVALUATION OF SURVEY POSITIONING METHODS FOR NEARSHORE MARINE AND ESTUARINE WATERS.
Tetra Tech, Inc., Bellevue, WA.
For primary bibliographic entry see Field 5A.
W88-11266

WATER QUALITY OF INTERSTATE STREAMS IN THE SUSQUEHANNA RIVER BASIN MONITORING REPORT FOR 1986 AND 1987 WATER YEARS,
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran.
Susquehanna River Basin Commission, Harrisburg, PA. Publication No. 118, June 1988. 98 p, 6 fig, 19 tab, 6 ref, 2 append.

Descriptors: *River basins, *Water quality, *Susquehanna River, *Monitoring, *Interstate Rivers, Chemical analysis, Bacteria, Biological studies, Streams, Water sampling, Coliforms, Turbidity, Chemung River, Conowingo Creek, Octoraro Creek, Deer Creek.

A water quality monitoring network consisting of fourteen stations on interstate streams in the Susquehanna River Basin was sampled monthly for chemical and bacteriological parameters between April 1986 and September 1987. Chemical quality was also determined from macroinvertebrate samples collected at these same sites during summer low flow periods. The monitoring program contributes to a database that is used to assess impacts on water quality standards, characterize ambient and seasonal stream quality, and assess trends. There were few observations of parameter values exceeding water quality standards. Fecal coliform was the most widespread pollutant. High concentrations were observed intermittently at almost every station, with the Susquehanna River at Sayre, Pennsylvania, the Chemung River, Conowingo Creek, Octoraro Creek and Deer Creek having persistent problems. High turbidities in the Chemung River, Octoraro Creek and Conowingo Creek were all associated with storm events. (Author's abstract)
W88-11285

7C. Evaluation, Processing and Publication

COMPARISON OF ECOTOXICOLOGICAL DATA BY MEANS OF AN APPROACH COMBINING CLUSTER AND CORRESPONDENCE FACTOR ANALYSIS,
Institut Pasteur de Lyon (France).
J. Devillers, A. Elmouaffek, D. Zakarya, and M. Chastrette.
Chemosphere CMSHAF, Vol. 17, No. 4, p 633-646, 1988. 4 fig, 4 tab, 36 ref.

Descriptors: *Toxicology, *Ecosystems, *Toxicity, *Chemical analysis, *Water pollution effects, Population exposure, Aquatic populations, Nickel, Cadmium, Phenol, Organic pollutants, Bacteria, Green algae, Protozoa, Crustaceans, Statistical analysis.

From an ecotoxicological data base of eight (sub)acute aquatic toxicity tests carried out on 59 pollutants (15 minerals and 44 organic compounds), a methodological approach combining an agglomerative heirarchical cluster analysis and a correspondence factor analysis was used to compare and interpret similarities between species and/

or chemicals. Among the 21 test chemicals were nickel chloride, silver nitrate, cadmium nitrate, phenol, ethyl acetate, propyl acetate, copper sulphate, and 2,4-dinitrophenol. These compounds were tested on eight freshwater organisms, including Pseudomonas putida, Microcystis aeruginosa, Scenedesmus quadricauda, Entosiphon sulcatum, Chilomonas paramaecium, Uronema parduczi, Daphnia magna, and Leuciscus idus melanotus. These samples represented bacteria, Cyanobacteria, green algae, protozoa (flagellates and ciliates), Crustacea, and fishes, respectively. The results were directly dependent on this data set. However, they did illustrate the high heuristic potency of the combined use of these two statistical techniques in analysis of ecotoxicological data. (Friedmann-PTT)
W88-10148

ESTABLISHMENT OF A TEST GUIDELINE FOR THE EVALUATION OF FISH TAINTING,
European Chemical Industry Ecology and Toxicology Centre, Brussels (Belgium).
C. L. M. Poels, R. Fischer, K. Fukawa, P. Howgate, and B. G. Maddock.
Chemosphere CMSHAF, Vol. 17, No. 4, p 751-765, 1988. 2 tab, 27 ref.

Descriptors: *Fish, *Contamination, *Organoleptic properties, *Path of pollutants, *Population exposure, *Water pollution effects, *Organic pollutants, Standards, Guidelines, Odors, Taste.

A test guideline has been established for determining the potential of a chemical to taint seafood. This guideline, based on the exposure of fish and the evaluation of the imparted taint by a triangular test, has been evaluated in a small ring test in which five laboratories tested four chemicals (butanol, pyridine, 1,2-dichlorobenzene, and 2,4-dichlorophenol) with three fish species (Salmo gairdneri, Pagrus major, and Cyprinus carpio). The guideline also contains a procedure for estimating the loss of taint from the test species during a depuration phase in clean water. None of the following factors appeared to have a large or systematic effect on the evaluation of the potential to cause taint: the performing laboratory; type of water used (sea- or freshwater); fish species; evaluation by flavor or by odor; method of preparation and presentation of samples for sensory evaluation. Although the results of the limited ring test showed that the proposed guideline is satisfactory and practical for the detection of chemicals that may taint fish, various gaps in our present knowledge exist, e.g., extent of the uptake and loss of lipophilic, hydrophilic and ionic chemicals by freshwater and seawater fish and the chemicals respective relative potential for tainting freshwater fish, seawater fish, crustaceans and mollusks. (Friedmann-PTT)
W88-10151

PERIODIC 18. 6-YEAR AND CYCLIC 10 TO 11 YEAR SIGNALS IN NORTHEASTERN UNITED STATES PRECIPITATION DATA,
State Univ. of New York at Stony Brook.
For primary bibliographic entry see Field 2B.
W88-10155

ONSET OF THE SOUTHWEST MONSOON OVER KERALA: 1901-1980,
Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 2B.
W88-10156

FREQUENCY OF DROUGHT AND SEVERE FIRE WEATHER IN NORTH-EASTERN WISCONSIN,
Wisconsin Univ., Madison. Dept. of Forestry.
For primary bibliographic entry see Field 2B.
W88-10198

PREDICTION OF THE MACRO-INVERTEBRATE FAUNA OF UNPOLLUTED RUNNING-WATER SITES IN GREAT BRITAIN USING ENVIRONMENTAL DATA,
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 2H.
W88-10210

MODEL FOR FLOOD PROPAGATION ON INITIALLY DRY LAND,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W88-10227

ALGORITHM FOR SELECTIVE WITHDRAWAL FROM STRATIFIED RESERVOIR,
Western Australia Univ., Nedlands. Centre for Water Research.
For primary bibliographic entry see Field 4A.
W88-10228

PREDICTION OF THREE-DIMENSIONAL THERMAL DISCHARGE FLOWS,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W88-10229

ENTROPY AND 2-D VELOCITY DISTRIBUTION IN OPEN CHANNELS,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-10230

RATIONALIZED ENERGY-LOSS PARAMETERS FOR CHANNELS,
Tasmania Hydro-Electric Commission, Hobart (Australia).
For primary bibliographic entry see Field 2E.
W88-10231

EFFECT OF BED AND SIDE ROUGHNESS ON DISPERSION IN OPEN CHANNELS,
Regional Engineering Coll., Srinagar (India).
For primary bibliographic entry see Field 2E.
W88-10232

TURBULENT BOUNDARY LAYERS IN VERTICAL CURVES,
Nanjing Hydrological Research Inst. (China).
For primary bibliographic entry see Field 8B.
W88-10233

GENERAL TWO-POINT METHOD FOR DETERMINING VELOCITY IN OPEN CHANNEL,
Geological Survey, Madison, WI.
J. F. Walker.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 801-805, July 1988. 2 fig, 1 tab, 4 ref, append.

Descriptors: *Flow characteristics, *Gaging, *Velocity, *Channel flow, *Open channels, Fluid mechanics, Hydrologic properties, Fluid flow, Mathematical analysis.

A general two-point depth-averaged method has been developed using a weighted average of measured velocities at two arbitrary but known locations. An expression for the general two-point depth-averaged velocity has been derived. With the exception of a few combinations of dimensionless vertical locations, delta sub one and delta sub two, the method is sufficiently accurate. However, there is a need to obtain further validation of the procedure using measured velocity profiles from a variety of natural channel sections. (Friedmann-PTT)
W88-10234

DISPERSIVE FORCE BASIS FOR CONCENTRATION PROFILES,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W88-10235

SCOUR DOWNSTREAM OF VERTICAL GATE,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W88-10236

NUMERICAL STUDIES OF ACIDIFICATION PROCESSES WITHIN AND BELOW CLOUDS WITH A FLOW-THROUGH CHEMICAL REACTOR MODEL,
Argonne National Lab., IL. Environmental Research Div.
For primary bibliographic entry see Field 2K.
W88-10238

TREND AND SEASONAL VARIATION OF PRECIPITATION CHEMISTRY DATA IN THE NETHERLANDS,
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 2B.
W88-10240

ACID RAIN IN SOUTHWESTERN CHINA,
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
For primary bibliographic entry see Field 2B.
W88-10241

TWO NEW DIATOM-BASED INDICES AND THE CHEMICAL QUALITY OF RUNNING WATERS: COMPARISON WITH VARIOUS EXISTING INDICES (DEUX NOUVEAUX INDICES DIATOMIQUE ET DE QUALITE CHIMIQUE DES EAUX COURANTES: COMPARAISON AVEC DIFFERENTS INDICES EXISTANTS,
Centre de Recherche et d'Education pour la Conservation de la Nature, Verviers (Belgium).
For primary bibliographic entry see Field 5A.
W88-10247

ADEQUACY OF LARGE-SCALE MODELS IDENTIFIED WITH INCOMPLETE FIELD DATA - A CASE STUDY WITH TWO LAKE MODELS,
Helsinki Univ. of Technology, Espoo (Finland). Lab. of Hydrology and Water Resources Engineering.
For primary bibliographic entry see Field 2H.
W88-10301

VICTORIA PROVINCE DROUGHT RELIEF PROJECT: II. BOREHOLE YIELD RELATIONSHIPS,
Hydrotechnica, Shrewsbury (England).
For primary bibliographic entry see Field 2F.
W88-10414

AUTOMATED NUMERICAL EVALUATION OF SLUG TEST DATA,
Shell Development Co., Houston, TX.
For primary bibliographic entry see Field 2F.
W88-10416

RECHARGE FROM A RIVER OF LARGE WIDTH TO A SHALLOW WATER-TABLE AQUIFER,
National Inst. of Hydrology, Roorkee (India).
For primary bibliographic entry see Field 2F.
W88-10417

AUTOMATED COMPUTATION OF PARAMETERS FOR LEAKY CONFINED AQUIFERS,
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
For primary bibliographic entry see Field 2F.
W88-10423

TRILINEAR DIAGRAM REVISITED: APPLICATION, LIMITATION, AND AN ELECTRONIC SPREADSHEET PROGRAM,
Arizona Univ., Tucson. Dept. of Geosciences.
S. Cheng.

Groundwater GRWAAR, Vol. 26, No. 4, p 505-510, July-August, 1988. 4 fig, 2 tab, 8 ref.

Descriptors: *Geochemistry, *Graphical methods, *Trilinear diagrams, Geohydrology, Aquifer characteristics, Computer programs, Lotus 1-2-3, Chemical properties, Spreadsheets, Minerals, Ionization, Groundwater movement, Quantitative analysis.

The trilinear diagram has been used extensively in hydrochemical studies. The concept of hydrochemical facies based on the trilinear diagram can effectively characterize the chemical composition of water in a qualitative manner. However, its application is rather limited for quantitative and precise study, because it is difficult, if not impossible, to distinguish various mechanisms that may cause similar change in water chemistry by this diagram alone. This limitation is illustrated with various hypothetical rock interactions and mixing trends plotted on the trilinear diagram. A set of simple equations is presented to transfer the tertiary system of the trilinear diagram to X-Y coordinates and electronic spreadsheet (i.e., Lotus 1-2-3) for plotting a trilinear diagram. For detailed hydrogeochemical investigations, such as water-rock interaction and quantitative hydrogeochemical study, one should include efforts such as consideration should be given to such data as isotopic composition, mineralogy, and reaction path simulation for screening hypotheses. The real mechanisms that are operating in a ground water system may elude the researcher if these hydrogeochemical approaches are ignored. (Author's abstract)
W88-10424

USE OF THE ROCK PRESERVATION SCALE IN GEOMECHANICAL INVESTIGATIONS AND CONSTRUCTION,
For primary bibliographic entry see Field 8E.
W88-10427

DETERMINATION OF THE LIFTING FORCE AND RATIONAL FORM OF VERTICAL LIFT-FALLING GATES,
For primary bibliographic entry see Field 8C.
W88-10434

HYDROGEOLOGY OF THE BISCAYNE AQUIFER,
Florida Atlantic Univ., Boca Raton. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W88-10443

MODELING OF PHYTOPLANKTON DEVELOPMENT IN A EUTROPHIC CHANNELIZED RIVER: LE LOT (FRANCE) (MODELISATION DU DEVELOPPMEMENT DU PHYTOPLANCTON DANS UNE RIVIERE CANALISEE EUTROPHE: LE LOT (FRANCE)),
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W88-10476

APPLICATION OF THE LINEAR PERTURBATION MODEL (LPM) TO FLOOD ROUTING ON THE MEKONG RIVER,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
For primary bibliographic entry see Field 2E.
W88-10494

UNSUPERVISED LANDSAT CLASSIFICATION PROCEDURE APPLIED TO LAKE POSIONJARVI, NE FINLAND,
Oulu Univ. (Finland). Dept. of Astronomy.
For primary bibliographic entry see Field 7B.
W88-10508

CURRENT RESTATEMENT AND CONTINUING REAPPRAISAL CONCERNING DEMOGRAPHIC VARIABLES IN AMERICAN TIME-TREND STUDIES ON WATER FLUORIDATION AND HUMAN CANCER,
For primary bibliographic entry see Field 5F.
W88-10513

CLUSTER ANALYSIS AS A TOOL IN THE STUDY OF GROUNDWATER QUALITY,
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W88-10546

FORECASTING THE STORM OF 15-16 OCTOBER 1987,
Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 2B.
W88-10565

GREAT STORM OF 15-16 OCTOBER 1987,
For primary bibliographic entry see Field 2B.
W88-10566

NEUTRON MOISTURE METER CALIBRATION IN LARGE DIAMETER BOREHOLES,
Nevada Univ. System, Reno. Water Resources Center.
For primary bibliographic entry see Field 2G.
W88-10648

REGRESSION TECHNIQUE FOR THE ESTIMATION OF EPIPHYTIC INVERTEBRATE POPULATIONS,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W88-10651

THERMAL AND CHEMICAL STRATIFICATION AND MIXING IN A SMALL TROPICAL RESERVOIR, SOLOMON DAM, AUSTRALIA,
James Cook Univ. of North Queensland, Townsville (Australia).
For primary bibliographic entry see Field 2H.
W88-10681

NUMERICAL MODEL OF NITROGEN FIXATION AND ITS APPLICATION TO LAKE VALENCIA, VENEZUELA,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2H.
W88-10729

MESOSCALE REPRESENTATIVENESS OF RAINFALL MEASUREMENTS FOR WINNIPEG,
Atmospheric Environment Service, Winnipeg (Manitoba).
For primary bibliographic entry see Field 2B.
W88-10778

OIL SPILL BEHAVIOR MODEL OF THE CANADIAN ATMOSPHERIC ENVIRONMENT SERVICE: PART I. THEORY AND MODEL EVALUATION,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W88-10779

OIL SPILL BEHAVIOR MODEL OF THE CANADIAN ATMOSPHERIC ENVIRONMENT SERVICE: PART II. EVALUATION OF MODEL GUIDANCE FOR EMERGENCY RESPONSE,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W88-10780

EXTENT AND INTENSITY OF THE ANOXIC ZONE ON BASINS AND FJORDS,
Washington Univ., Seattle. Fisheries Research Inst.
For primary bibliographic entry see Field 2L.
W88-10784

MODELING OF HIERARCHICAL STRUCTURES IN WATER QUALITY CONTROL,
Ceskoslovenska Akademie Ved, Prague. Ustav Teorie Informace a Automatizace.
For primary bibliographic entry see Field 5G.
W88-10808

ERRORS OF DETERMINING MATERIAL LOAD FROM A WATERSHED,
Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
I. Nesmerak.
Limnologica LMNOA8, Vol. 17, No. 2, p 251-254, October 1986. 1 fig, 3 tab, 4 ref.

Descriptors: *Sediment load, *Error analysis, *Sediment transport, *Mathematical studies, On-site data collections, Data acquistions, Catchments, Data interpretation.

The determination of the error of the average material load calculated as a product of the average concentration and the average water flow is considered. The problem is solved for the general function of two variables after Taylor series expansion as well as in a more simple way for the case of the product of two variables. The error equals the covariance of concentrations and water flows. The desired frequency of observations for estimating the average material load by the expansion of the function into Taylor series was determined approximately. (Author's abstract)
W88-10810

NITRATES AND MINERAL NITROGEN FERTILIZATION,
Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 5B.
W88-10814

IMPROVEMENT OF THE MITRE MODEL FOR PRIORITIZATION OF HAZARDOUS WASTE SITE REMEDIATION,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W88-10870

COMBINATION OF MATHEMATICAL AND HYDRAULIC MODELING METHODS WHEN ANALYZING UNSTEADY REGIMES IN CANALS,
For primary bibliographic entry see Field 8B.
W88-10876

IMPROVEMENT OF HYBRID MODELING,
For primary bibliographic entry see Field 8B.
W88-10887

ANAEROBIC ACIDOGENESIS OF A COMPLEX WASTEWATER: II. KINETICS OF GROWTH, INHIBITION, AND PRODUCT FORMATION,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
For primary bibliographic entry see Field 5D.
W88-10896

URBAN STORMWATER FLOW RATE AND QUALITY PREDICTION: THE FLUPOL MODEL (PREVISION DES DEBITS ET DES FLUX POLLUTANTS TRANSITES PAR LES RESEAUX D'EGOUTS PAR TEMPS DE PLUIE: LE MODELE FLUPOL),
Compagnie Generale d'Automatisme, Paris (France).
For primary bibliographic entry see Field 4C.
W88-10904

USE OF PC SPREADSHEET MODELS AS A ROUTINE ANALYTICAL TOOL FOR SOLVING GROUND WATER PROBLEMS,
Highland Associates, Golden, CO.
For primary bibliographic entry see Field 2F.
W88-10979

SOFTWARE PACKAGE OF GROUND WATER MODELING AND ITS APPLICATIONS,
Shandong Univ., Jinan (China).
For primary bibliographic entry see Field 2F.
W88-10988

RESEARCH NEEDS IN VALIDATING AND DETERMINING THE PREDICTABILITY OF LABORATORY DATA TO THE FIELD,
Colorado State Univ., Fort Collins. Water Resources Lab.
T. P. Boyle.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 61-66, 2 tab, 22 ref.

Descriptors: *Research priorities, *Toxicology, *Water pollution effects, *Data interpretation, *Environmental effects, *Aquatic toxicology, *Fate of pollutants, Model studies, Toxicity, Sensitivity analysis, Stress, Ecological effects.

Three areas of research needs are identified in translating laboratory data to the field. They are: (1) an assessment of the efficiency of existing environmental fate mathematical and physical models to simulate field conditions; (2) an evaluation of the utility of single species laboratory toxicity tests to accurately assess environmental effects of contaminants; and (3) an assessment of the relative sensitivities of ecological functional processes to stress. Ideas on how to address these research needs are presented. (See also W88-10991) (Author's abstract)
W88-10998

TIME/TOXICITY RELATIONSHIPS IN SHORT-TERM STATIC, DYNAMIC, AND PLUG-FLOW BIOASSAYS,
SRI International, Menlo Park, CA. Aquatic Toxicology Program.
H. C. Bailey, D. H. W. Liu, and H. A. Javitz.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 193-212, 4 fig, 11 tab, 10 ref. EPA Contract 68-01-4108.

Descriptors: *Toxicology, *Aquatic toxicology, *Bioassay, *Toxicity, *Water pollution effects, Fish, Lethal limits, Bluegill, Acrylonitrile, Ammonia, Chlorobenzene, Data interpretation, Chromic acid, Copper sulfate, Ethoxyethylacetate, Methylmethacrylate, Sodium hydroxide, Water quality control, Sulfuric acid, Xylene, Plug flow, Regression analysis.

In order to determine the efficacy of using data from 96-h acute bioassays for predicting toxicity associated with shorter exposure periods, a series of static, dynamic, and plug-flow bioassays were performed using bluegill as test organisms. Test chemicals included acrylonitrile, ammonia, chlorobenzene, chromic acid, copper sulfate, 2-ethoxyethylacetate, methylmethacrylate, sodium hydroxide, sulfuric acid, and xylene. Exposure durations ranged from 1 to 96 h. Regression techniques were used to develop time-toxicity curves to determine how well short-term toxicity could be predicted by 24 to 96 h data. The results from these experiments indicate that data from 24 to 96-h exposure periods have limited use in predicting toxicity associated with shorter exposure periods, depending on the desired level of precision of the estimate. In extreme cases, the estimated LC50 ranged from twenty-fold below to three-fold above the observed LC50 values. In most cases, however, agreement between the estimated and actual LC50 values was much closer. While the usefulness of such mathematical predictors remains to be established, they could have merit in assessing the potential toxicity associated with single-event exposures such as chemical spills or runoff events. (See also W88-10991) (Author's abstract)
W88-11006

ADVANTAGES OF USING REGRESSION ANALYSIS TO CALCULATE RESULTS OF CHRONIC TOXICITY TESTS,
Environmental Research Lab.-Duluth, MN.
C. E. Stephan, and J. W. Rogers.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium. A Symposium Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. American Society of Testing Materials, Philadelphia, Pennsylvania. Special Technical Publication 891, 1985. p 328-338, 30 ref.

Descriptors: *Tolicology, *Sublethal effects, *Toxicity, *Aquatic toxicology, *Regression analysis, *Water pollution effects, Statistical analysis, Data interpretation, Biological studies.

Although results of most chronic toxicity tests have been calculated using hypothesis testing to detect statistically significant differences from the control, calculation of results using regression analysis offers several major advantages. By deriving an equation for the concentration-effect relationship, regression analysis allows estimation of the concentration corresponding to a specified amount of an adverse effect or estimation of the amount of effect corresponding to a specified concentration. In addition, whereas the number of replicates, agreement between replicates, and selection of alpha (the acceptable level of Type 1 error) have no impact on the estimate of the endpoint concentration calculated using regression analysis, they have a great impact on decisions concerning whether tested concentrations caused statistically significant differences. Further, use of regression analysis emphasizes the necessity of considering the biological importance of the adverse effects observed in toxicity tests. By using hypothesis testing, aquatic toxicologists have been able to avoid this difficult, important question by presenting results in terms of a variable 'statistically significant difference.' (See also W88-10991) (Author's abstract)
W88-11017

COMPUTERIZED DATA BASES FOR GROUND WATER MANAGEMENT: THE SOUTHWEST MICHIGAN GROUND WATER PROGRAM,
Western Michigan Univ., Kalamazoo.
For primary bibliographic entry see Field 4B.
W88-11035

USE OF MULTIPLE PATHWAY COMPUTER CODES FOR ASSESSMENT OF HEALTH EFFECTS FROM LOW-LEVEL RADIOACTIVE WASTE,
Rogers and Associates Engineering Corp., Salt Lake City, UT.
For primary bibliographic entry see Field 5C.
W88-11051

INTERPRETATION OF GROUND WATER MONITORING DATA -- AN INTEGRATED SYSTEMS APPROACH,
AWARE, Inc., West Milford, NJ.
M. R. Brother, and J. H. Clarke.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 70-96, 8 fig, 8 tab, 5 ref.

Descriptors: *Groundwater monitoring, *Statistical methods, *Monitoring, *Water quality control, *Data interpretation, Frequency analysis, Systems analysis, Regression analysis.

Groundwater monitoring requirements, developed in accordance with the Resource Conservation and Recovery Act, specify procedures to be followed concerning data collection and interpretation at land-based hazardous waste management facilities. One approach to the development of an effective groundwater quality data management system is discussed. Indicator parameter data from upgradient and downgradient monitoring points are compared using the Student's t-test to determine if statistically significant differences exist. Statistical methods are just one factor to be considered in the development of a systems approach to the evaluation of ground waterquality data. Such an approach must include review of data in the context of their geologic, hydrogeologic, spatial, and temporal setting. Statistics alone are rarely sufficient. By using a variety of statistical tools, one can often develop an evaluation of the data sufficient to determine whether or not false positives are, in fact, indicated by one statistical test. Moreover, when viewed in context, many false positives can be rationally attributed to known phenomena not necessarily related to actual water quality changes. This approach has considerable merit and should benefit everyone involved in the groundwater monitoring decision-making process. (See also W88-11084) (Author's abstract)
W88-11091

MODEL FOR MANAGEMENT OF LOCAL GROUND WATER SUPPLIES -- MOUNTAIN VALLEY SPRING,
Arkansas Univ., Fayetteville. Dept. of Geology.
For primary bibliographic entry see Field 4B.
W88-11092

AGRICULTURE AND GROUND WATER QUALITY,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W88-11094

IMPORTANCE OF STRESS RELIEF FRACTURING IN PREDICTING GROUND WATER MOVEMENT AND UNDERGROUND MINING EFFECTS,
Brown Engineering, Washington, IL.
For primary bibliographic entry see Field 2F.
W88-11101

GEOSTATISTICAL ESTIMATION OF PARAMETERS FOR THE SPARTA SAND AQUIFER -- NORTH LOUISIANA,
Louisiana Tech Univ., Ruston.
For primary bibliographic entry see Field 2F.
W88-11102

GEOLOGIC AND GEOPHYSICAL CHARACTER OF FRACTURE ZONES IN A CARBONATE AQUIFER,
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-11103

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, MAY 1985,
Geological Survey, Tampa, FL. Water Resources Div.
G. L. Barr.
Available from OFSS, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-482, 1981. 1 sheet (map), 2 fig, 2 ref.

Descriptors: *Maps, *Potentiometric level, *Hydrogeology, *Florida, *Groundwater movement, Potentiometric flow, Hydrology.

A May 1985 potentiometric surface map of the upper Floridan aquifer in west-central Florida depicts the annual low water-level period. Most areas of west-central Florida were experiencing drought conditions and water levels were at or approaching

near-record low levels. Water levels in most wells in May 1985 were lower than in September 1984. May levels averaged about 5 feet lower than September levels in areas north of latitude 28 degree 07 minutes and about 13 feet lower in southern areas. Generally, water levels in May 1985 were lower when compared to May 1984. Water levels in most wells measured in May 1985 averaged about 4 feet lower than May 1984 levels in the north and about 6 feet lower in the south. (USGS)
W88-11119

FINITE-ELEMENT SIMULATION MODEL FOR SATURATED-UNSATURATED FLUID DENSITY-DEPENDENT GROUNDWATER FLOW WITH ENERGY TRANSPORT OR CHEMICALLY-REACTIVE SINGLE-SPECIES SOLUTE TRANSPORT,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-11120

PROCEEDINGS TO THE NWWA FOCUS CONFERENCE ON NORTHWESTERN GROUND WATER ISSUES.
For primary bibliographic entry see Field 2F.
W88-11121

USING THE STATISTICAL ANALYSIS SYSTEM FOR GROUND WATER DATA ANALYSIS,
Army Engineer District, Portland, OR.
For primary bibliographic entry see Field 2F.
W88-11125

SWIFT CURRENT VALLEY: A GLACIALLY DISRUPTED BURIED-VALLEY AQUIFER SYSTEM,
Hardy BBT Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 2F.
W88-11131

HYDROGEOCHEMICAL ANALYSIS OF COLD CREEK AND BLAYNE SPRING, ENNIS, MONTANA,
Greiner Engineering Sciences, Inc., Tampa, FL.
For primary bibliographic entry see Field 2E.
W88-11133

APPLICATION OF REMOTE DATA ACQUISITION SYSTEMS IN ASSESSING GROUND WATER FLOW DIRECTIONS,
Hart Crowser, Inc., Seattle, WA.
For primary bibliographic entry see Field 7B.
W88-11136

PREDICTING PLUME CHARACTERISTICS FROM PUMPING WELL CONCENTRATIONS USING A ONE-DIMENSIONAL ANALYTICAL SOLUTION,
Hydrosystems, Inc., Falls Church, VA.
For primary bibliographic entry see Field 5B.
W88-11138

ESTIMATION OF THE UNSATURATED HYDRAULIC PROPERTIES FOR RESIDUAL SOILS IN A CENTRAL IDAHO WATERSHED,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W88-11142

ESTIMATING AIR, WATER AND HYDROCARBON CONDUCTIVITY OF SOILS FROM FIELD MEASURABLE PROPERTIES,
Soil and Material Engineers, Cincinnati, OH.
For primary bibliographic entry see Field 2G.
W88-11143

GROUND WATER INVESTIGATION AND DATA COMPILATION FOR GAS WORKS PARK, SEATTLE, WASHINGTON,
Tetra Tech, Inc., Bellevue, WA.
For primary bibliographic entry see Field 2F.
W88-11151

QUALITY ASSURANCE FOR ENVIRONMENTAL MEASUREMENTS.
American Society for Testing and Materials, Philadelphia, PA. A symposium sponsored by ASTM Committee D-19 on Water and Committee D-22 on Sampling and Analysis of Atmospheres, Boulder, Colo., 8-12 Aug. 1983. ASTM Special Technical Publication 867. ASTM Publication Code Number 04-867000-16. 1985. 441 p. Edited by J.K. Taylor and T.W. Stanley.

Descriptors: *Hydrologic data, *Water quality data, *Quality control, *Data acquisition, *Environmental data, *Water analysis, *Air pollution, Sampling, Data processing.

The purpose of the papers presented at this conference was to address quality assurance in environmental measurement data. The measurement system includes sampling, analysis, quality control, data processing, and reporting. The conference focused on the following questions: What is quality assurance; what is its role in the measurement process; what are the benefits of quality assurance. (See W88-11159 through W88-11181) (Friedmann-PTT)
W88-11158

WHAT IS QUALITY ASSURANCE,
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
J. K. Taylor.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 5-11, 1 tab, 14 ref.

Descriptors: *Chemical analysis, *Quality control, *Data acquisition, *Statistical analysis, Project planning, Precision, Environmental data.

The quality of data must be known and established before it can be used logically in any application. Data quality may be judged on the basis of its quantitative accuracy and on the confidence that can be placed in the qualitative identification of the parameters measured. This requires the production of data in a quality assurance program that permits the assignment of its statistically supported limits of uncertainty. The essential features of such a program, consisting of quality control and quality assessment techniques, are discussed. The basic ingredients of a good measurement program are appropriate methodology, adequate calibration, and proper usage. Good laboratory practices and proper documentation are also essential for a good quality control program. Measuring an appropriate selection of duplicate samples of the actual test samples evaluates precision. System audits are required to determine that the quality assurance program is operating as required. Ten guidelines for producing quality data are offered including the allocation of sufficient resources for R&D on methodology and the use of only dependable suppliers of reagents and equipment. (Friedmann-PTT)
W88-11159

U.S. ENVIRONMENTAL PROTECTION AGENCY'S QUALITY ASSURANCE PROGRAM,
Environmental Protection Agency, Washington, DC. Quality Assurance Management Staff.
T. W. Stanley, and S. S. Verner.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 12-19, 2 ref.

Descriptors: *Quality control, *Environmental data, *Data acquisitions, *Environmental Protection Agency, *Sampling, *Data processing, Environmental policy, Administrative aspects, Planning.

The Environmental Protection Agency (EPA) and its predecessor organizations historically have devoted considerable time and effort to the standardization of test procedures, the development and use of calibration and performance audit procedures, quality control and reference samples, training, and other quality assurance (QA) activities. However, these QA activities were essentially voluntary, and most of the data generated were reported with no indication of quality, thereby severely reducing their usefulness. Due to questions concerning the quality of EPA's data, Agency policy stipulated in 1979, requires participation in a centrally managed QA program by all organizational units engaged in environmentally related measurements. This policy applies equally to those extramural efforts performed on behalf of EPA. The primary responsibility for program development and direction is assigned to the Office of Research and Development, while other program offices, regions, and laboratories are responsible for its implementation. Essential elements of the program include developing and implementing QA program plans, QA project plans, and standard operating procedures; conducting audits of the capability and performance of measurement systems, and data quality; maintaining a mechanism for corrective actions; QA training; and frequent reports to management on a mechanism on the quality of data, program effectiveness, and problems. The goal of the QA program is to ensure that all data generated are of known, documented, and acceptable quality. (See also W88-11158) (Author's abstract)
W88-11160

DETERMINATION OF MEASUREMENT DATA QUALITY AND ESTABLISHMENT OF ACHIEVABLE GOALS FOR ENVIRONMENTAL MEASUREMENTS,
Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.
W. J. Mitchell, R. C. Rhodes, and F. F. McElroy.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 41-52, 4 fig, 5 ref.

Descriptors: *Quality control, *Data acquisitions, *Monitoring, Environmental Protection Agency, Data interpretation, Precision.

In recognizing the need for measuring and documenting the quality of environmental measurements obtained in its monitoring projects and for getting achievable data quality goals for such projects, the Environmental Protection Agency, issues a number of guidance and informational documents addressed to those needs. This paper reviews one of those documents, a comprehensive compilation of the quality of measurements actually obtained with various environmental measurement methods in all environmental media. Included are a brief discussion of the rationale and purpose of the document, limited reviews of the four designated measures of data quality (precision, accuracy, completeness, and method detection limit), and explanations of the format used to list the data quality information. Examples of actual data listings from the document are also included. (See also W88-11158) (Author's abstract)
W88-11162

CERTIFICATION OF LOCAL LABORATORIES ANALYZING DRINKING WATER IN NONPRIMACY STATES,
Environmental Protection Agency, Denver, CO. Region VIII.
For primary bibliographic entry see Field 5A.
W88-11164

QUALITY ASSURANCE OF U.S. GEOLOGICAL SURVEY WATER-QUALITY FIELD MEASUREMENTS,
Geological Survey, Doraville, GA.
D. E. Erdmann, and J. D. Thomas.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 110-115, 1 fig, 3 tab.

Descriptors: *Water quality, *Water analysis, *Quality control, Chemical analyis, Data acquisi-

tion, On-site investigations, Administrative agencies, Hydrogen ion concentrations.

Each year many thousands of water quality measurements are made in the field by personnel of the U.S. Geological Survey's Water Resources Division. To insure the accuracy of these measurements, an external quality assurance program was officially established in March 1979. The initial phase of this program was concerned with specific conductance and pH measurements. Reference samples are submitted semiannually to field analysts for measurement of these parameters with the same techniques and instruments used in the field. Both the personnel and the instruments involved in making the determinations are recorded. When the data are complete, a report defining the quality of the analytical results is prepared and circulated to appropriate District, Regional, and National offices. Field data, in addition to their immediate use, are normally placed in a national data base and are available to all hydrologists. As a result the quality of field measurements can have a profound effect on their investigations. The quality assurance program described is designed to insure that the field data of the Water Resources Division are highly accurate. (See also W88-11158) (Author's abstract)
W88-11165

ANALYTICAL METHOD AND QUALITY CONTROL PROGRAM FOR STUDIES OF CURRENTLY USED PESTICIDES IN SURFACE WATERS,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 5A.
W88-11166

QUALITY ASSURANCE FOR MICROBIOLOGICAL ANALYSES OF WATER,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
R. H. Bordner.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 133-143, 5 tab, 7 ref.

Descriptors: *Quality control, *Microbiological studies, *Analytical studies, *Water analysis, Administrative agencies, Facilities, Laboratories, Wastewater, Certification, Drinking water.

The establishment of microbiological contaminant limits for water and wastewater and the implementation of enforcement programs that require monitoring of these limits have emphasized the need to develop and practice quality assurance (QA) programs. A broadscope QA program is essential for microbiological determinations. The basic elements of an intralaboratory quality control (QC) program are described, which include controls over personnel, facilities, sampling techniques, laboratory operations, analytical procedures, and data reporting. Formal, written analytical procedures, a QA protocol, and complete QC records are indispensable to a QA program. The laboratory should participate in an interlaboratory QC program established to maintain minimal analytical and operational standards. The U.S. Environmental Protection Agency (EPA) certification program for analyzing public drinking water supplies is described as an example of a national interlaboratory program. Guidelines provided by the EPA for laboratory QA programs are outlined. (See also W88-11158) (Author's abstract)
W88-11167

OVERVIEW OF THE NATIONAL DISCHARGE MONITORING REPORT (DMR) QUALITY ASSURANCE (QA) PROGRAM,
Environmental Protection Agency, Washington, DC. Office of Water Enforcement and Permits.
G. R. Polvi, Y. S. To, and E. C. Lim.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 189-199, 4 tab, 7 ref.

Descriptors: *Laboratories, *Statistical analysis, *Quality control, *Wastewater treatment, *Monitoring, Water quality control, Water analysis, Permits, Investigations, Legal aspects, Administrative regulations.

As mandated by the Clean Water Act, wastewater treatment facilities are regulated under the National Pollutant Discharge Elimination System (NPDES). Direct discharges have unique NPDES permit with discharge limits and a self-monitoring requirement. The effectiveness of the NPDES Program hinges on the quality of the self-monitoring data. The DMR QA Program evaluates the data quality from the NPDES permittees. Since 1978, the Program has helped to assure the data quality of DMRs. Under this Program, all major permittees are annually sent performance samples, to be analyzed and reported the same way as required in the permits. The results of these permittee tests are compared with an established range of acceptance for each test parameter by EPA to identify potential problems with analytical or reporting procedures. EPA/State then follow-up through correspondence or on-site visits with permittees to resolve the problems. As an overview, the history, authority procedures, use of data, and implementation issues are reviewed. (See also W88-11158) (Author's abstract)
W88-11168

QUALITY ASSURANCE AS AN ELEMENT OF WISCONSIN'S NPDES PROGRAM,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5D.
W88-11169

DEVELOPMENT OF STATISTICS AND LIMITS FOR DMR-QA STUDIES, AND SUMMARY OF EXPERIENCE IN DMR-QA STUDY 2,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Quality Assurance Branch.
P. W. Britton.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 206-215, 4 tab, 2 ref.

Descriptors: *Monitoring, *Quality control, *Statistical analysis, *Water analysis, *Water quality control, Administrative agencies, Laboratories, Legal aspects, State jurisdiction.

The U.S. Environmental Protection Agency (EPA) has conducted two Discharge Monitoring Report - Quality Assurance (DMR-QA) studies to evaluate the performance of laboratories doing analyses required in major National Pollution Discharge Elimination System (NPDES) permits. The object of these studies is to identify laboratories that appear to be having significant analytical problems and that should receive follow-up contact by the state or EPA region with primacy. Participants receive a set of sample concentrates to be diluted to volume with distilled water. The resulting samples can be analyzed for 26 of the analytes most frequently limited in permits. Analytical results are submitted to EPA for evaluation against appropriate acceptance limits and a report is returned to each participant. The acceptance limits are constructed as 99% confidence intervals based upon the state-of-the-art analytical capabilities demonstrated by participating EPA and state laboratories. The statistical basis for the acceptance limits in the most recent study, DMR-QA Study 2, is discussed. DMR-QA Study 2 included data representing 5157 major NPDES permits and all 50 states. On the average, 22% of these data were beyond the acceptance limits, indicating there is considerable potential for improvement. Results from DMR-QA studies focus the limited follow-up resources of the primacy agencies to maximize the improvement in DMR data quality. Whether any improvement actually occurs, however, depends entirely upon the commitment of the responsible state and EPA enforcement offices, as well as the major NPDES discharges, to make the changes necessary to improve the quality of monitoring data. (See also W88-11158) (Author's abstract)
W88-11170

PULP AND PAPER INDUSTRY EXPERIENCE WITH NPDES QUALITY ASSURANCE REQUIREMENTS,
National Council of the Paper Industry for Air and Stream Improvement, Inc., Gainesville, FL.
R. P. Fisher.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 216-236, 1 tab, 30 ref.

Descriptors: *Quality control, *Monitoring, *Pulp and paper industry, Administrative regulations, Industrial waste, Sampling, Water analysis, Pulp wastes, Effluent, Water quality control.

Representatives of the pulp and paper industry in the U.S. have assembled guidelines for preparation for regulatory agency inspections of the framework of quality assurance associated with self-monitoring data collected for National Pollutant Discharge Elimination System (NPDES) discharge monitoring report purposes. These guidelines address effluent flow measurement; sample collection, preservation, and analysis; analysis methods quality control; and record keeping. The guidelines are summarized and examples of the experience of the industry with quality assurance-oriented inspections are presented. In an effective quality assurance program, three features are present with respect to documentation: (1) every activity which relates to the Discharge Monitoring Report must be documented; (2) the documentation program should be hierarchical; and (3) the program should stress ease of inspection. (See also W88-11158) (Friedmann-PTT)
W88-11171

MONSANTO ANALYTICAL TESTING PROGRAM FOR NPDES DISCHARGE SELF-MONITORING,
Monsanto Research Corp., St. Louis, MO.
T. J. Hoogheem, and L. A. Woods.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 237-241, 3 tab, 3 ref.

Descriptors: *Industrial wastes, *Water analysis, *Quality control, *Monitoring, Administrative regulations, Administrative agencies, Precision, Permits, Laboratories.

The Monsanto Analytical Testing (MAT) program was devised and implemented in order to provide analytical standards to Monsanto manufacturing plants involved in the self-monitoring of plant discharges as required by National Pollutant Discharge Elimination System (NPDES) permit conditions. Standards are prepared and supplied at concentration levels normally observed at each individual plant. These levels were established by canvassing all Monsanto plants having NPDES permits and by determining which analyses and concentrations were most appropriate. Standards are prepared by Monsanto's Environmental Sciences Center (ESC) using Environmental Protection Agency (EPA) methods. Eleven standards are currently available, each in three concentrations. Standards are issued quarterly in a company internal round-robin program or on a per request basis or both. Since initiation of the MAT program in 1981, the internal round-robin program has become an integral part of Monsanto's overall Good Laboratory Practices (GLP) program. Results have shown that the company's plant analytical personnel can accurately analyze and report standard test samples. More importantly, such personnel have gained increased confidence in their ability to report accurate values for compounds regulated in their respective plant NPDES permits. (See also W88-11158) (Author's abstract)
W88-11172

DISCHARGE MONITORING REPORT QUALITY ASSURANCE RESULTS AND FOLLOW-UP BY REGION VIII U.S. ENVIRONMENTAL PROTECTION AGENCY,
Environmental Protection Agency, Denver, CO. Region VIII.

C. L. Campbell, and J. J. Hillman.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 242-249, 3 tab, 4 ref.

Descriptors: *Quality control, *Water analysis, *Monitoring, Water quality control, Inspection, Legal aspects, Environmental Protection Agency, Permits, Administrative regulations, Administrative agencies.

The U.S. Environmental Protection Agency (EPA) is conducting a national quality assurance program known as the Discharge Monitoring Report Quality Assurance Program (DMRQA). Facilities holding permits under the National Pollutant Discharge Elimination System (NPEDES) have been sent two sets of audit samples to analyze for permit-required parameters. EPA Region VIII permittees have performed on the average better than other permittees participating nationally in DMRQA Studies One and Two. Follow-up on DMRQA Study One included phone calls, letters, and inspections. Permittee performance in Study Two has improved as a result of Study One follow-up activities. Study Two follow-up will be more extensive than Study One and is currently underway. (See also W88-11158) (Author's abstract)
W88-11173

QUALITY ASSURANCE IN ACID PRECIPITATION MEASUREMENTS,
Martin Marietta Environmental Systems, Columbia, MD.
S. Campbell, and H. Scott.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 272-283, 4 tab, 15 ref.

Descriptors: *Acid rain, *Quality control, *Hydrogen ion concentration, *Water analysis, *Sampling, *Standards, Laboratories, Data processing.

The growing interest in acid deposition has led to a proliferation of laboratories engaged in such studies. High-level quality assurance (QA) procedures are required for each program to standardize the diverse measurement methods in use and to determine the validity of differences in measurements widely separated in space and time. Both in-laboratory (quality control) and external (quality assurance) procedures are required. A complete QA program for acid precipitation measurements must address program objectives; site selection and operation; operator selection and training; sample collection, handling, and analyses; and data checking, storage, retrieval, and transmission. Objective criteria must be developed for detecting adulterated samples and invalid data. Appropriate laboratory and field blanks must be collected and analyzed. Standard techniques (sample spiking, replicate analysis of standards and samples) should ensure the reliability of analytical results. Relevant quality assurance data, including analytical detection limits, blank values, and the variability of replicate determinations, must be supplied with each data transmittal. Experimental information should be available upon request. The measurement of the pH of dilute solutions such as rain is particularly difficult; differences as large as 0.3 pH unit may be observed in replicate analyses of the same sample using different electrode types. Laboratory results demonstrated typical variability to be expected in the collection, storage, and analysis of rainwater for major ions, including hydrogen ion. (See also W88-11158) (Author's abstract)
W88-11174

ROLE OF NBS STANDARD REFERENCE MATERIALS IN QUALITY ASSURANCE OF ENVIRONMENTAL MEASUREMENTS,
National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.
R. Alvarez.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 346-359, 3 tab, 18 ref.

Descriptors: *Standard reference materials, *Chemical analysis, *Pollutant identification, *Sediments, *Water analysis, Water quality, Adminstrative agencies, Precision, Particulate matter, Guidelines.

Analyses of environmental samples of unknown homogeneity by different laboratories often disagree seriously. Discrepant data may result from poor methodology, improper instrument calibration, faulty experimental techniques, or from a combination of these factors. One approach towards obtaining accurate data is through the use of Standard Reference Materials (SRMs) issued by the National Bureau of Standards under federal statutes. SRMs are homogeneous, stable materials with certified chemical or physical properties, and are used in calibrating instruments, validating laboratory data, developing methods of known accuracy, and referring data from different laboratories to a common base. Of the approximately 900 SRMs listed in the current SRM catalog, over 90 have been developed for use in improving the accuracy of environmental analyses. Environmental matrix SRMs certified for priority pollutants include gases, atmospheric dust, water, sediments, biological materials, and fuels. In addition, calibrator solutions of organic priority pollutants, such as halocarbons, and polycyclic aromatic hydrocarbons, are available for determining instrumental response factors, and adding accurate amounts of these compounds to samples. (See also W88-11158) (Author's abstract)
W88-11177

ESTABLISHING AN ENVIRONMENTAL QUALITY ASSURANCE PROGRAM,
Utah Univ. Research Inst., Salt Lake City. UBTL Div.
L. M. Eggenberger.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 391-406, 6 fig, 3 ref.

Descriptors: *Planning, *Water analysis, *Quality control, *Management, *Data interpretation, Long-term planning, Guidelines, Environmental quality, Sampling, Water quality control, Water quality.

Specific steps leading to the establishment of an Environmental Quality Assurance Program in an analytical laboratory are enumerated and discussed. Aspects of a model Quality Assurance Program that applies fundamental principles and methods to selected laboratory instrumentation and analytical protocols for the attainment of accurate, reliable results are reviewed. Discussion includes specific factors such as method validation, certification, sample handling, security, documentation, and continuing data assessment. Objectives and problem areas characteristic of newly implemented programs, such as building a data base, interim control limits, reference standards, and categorizing and setting priorities for prospective control areas, are included. (See also W88-11158) (Author's abstract)
W88-11180

INTERLABORATORY QUALITY ASSURANCE ASPECTS OF THE INTERNATIONAL JOINT COMMISSION'S GREAT LAKES MONITORING PROGRAMS,
National Water Research Inst., Burlington (Ontario). Quality Assurance and Methods Section.
K. I. Aspila, R. E. White, and J. L. Clark.
IN: Quality Assurance for Environmental Measurements. American Society for Testing and Materials, Philadelphia, PA. 1985. p 407-421, 6 tab, 6 ref.

Descriptors: *Quality control, *Great Lakes, *Data acquistion, *Water analysis, Laboratories, Guidelines, Water quality, Environmental quality, Sediments, Fish populations, Administrative regualtions, Sampling, Networks.

Quality assurance activities that identify comparability of environmental data produced by over 50 laboratories that support the Canada-United States Great Lakes International Surveillance Program are described. The activities include the development and use of stable natural reference standards for waters, sediments, and fish in an interlaboratory comparison studies program. The interlaboratory studies are designed to include 10 to 15 stable natural samples that for most studies are analyzed for 10 to 15 constituents by 25 to 35 laboratories. A typical simple study on total phosphorus in water is described. Interlaboratory results for each sample are ranked and then laboratory measurement bias identified by the method of Youden. Results deviating significantly from the interlaboratory median values are flagged by the method of Clark. A laboratory specific report is then prepared and provided to each participating laboratory and is made available to report writers who must typically work with results from different laboratories. These quality assurance activities are constructive and effective. Remedial measures are taken to improve the laboratory measurement process. (See also W88-11158) (Author's abstract)
W88-11181

HYDROGEOLOGIST AND DATA ACQUISITION FOR AQUIFER MODELING: QUO VADIS,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 2F.
W88-11203

PRELIMINARY RESULTS OF A STEADY-STATE GROUND WATER FLOW MODEL OF THE SOUTHEASTERN COASTAL PLAIN REGIONAL AQUIFER SYSTEM,
Geological Survey, Atlanta, GA.
For primary bibliographic entry see Field 2F.
W88-11204

PREDICTING NON-IONIC ORGANIC CHEMICAL SORPTION AND ATTENUATION IN SOLVENT-WATER SOIL SYSTEMS,
Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5B.
W88-11205

DATA ANALYSES AND COMPUTER MODELING OF THE BENZENE PLUME IN AN AQUIFER BENEATH A GAS PLANT,
For primary bibliographic entry see Field 5B.
W88-11223

FEASIBILITY OF INFRARED SPECTROSCOPIC IDENTIFICATION OF CRUDE OIL WASTE BRINES,
Michigan Dept. of Public Health, Lansing.
For primary bibliographic entry see Field 5A.
W88-11230

FRONTIERS OF MASSIVELY PARALLEL SCIENTIFIC COMPUTATION.
Available from NTIS, Springfield, VA. 22161, as N87-26531. Price codes: A10 in paper copy, A01 in microfiche. Proceedings of the First Symposium Sponsored by the National Aeronautics and Space Administration and the Goodyear Aerospace Corporation, NASA Goddard Space Flight Center, Greenbelt, MD, September 24-2[illegible] 1986. NASA Conference Publication 2478, July 1987. 321 p. Edited by J. R. Fishcher.

Descriptors: *Simulation analysis, *Computers, *Data interpretation, *Data acquisition, Physics, Computer programs, Algorithms, Mathematical equations, Graphics.

Practical scientific applications using massively parallel computer hardware first appeared on the research scene during the 1980s. Representative of the first generation of this new class of computer hardware is the Massively Parallel Processor (MPP), located at NASA's Goodard Space Flight Center in Greenbelt, Maryland. Through a national solicitation initiated in 1984 by NASA's Office of Space Science and Applications (OSSA), a team of scientists from around the country was provided

the opportunity to test and implement their computational algorithms on the MPP. The research endeavors of the MPP investigators span a broad variety of applications including earth sciences, physics, signal and image processing, computer science, and graphics. The performance of these applications on the MPP was very good. Invited papers include one discussing the programming of a hillsope water movement model on the MPP. (See also W88-11265) (Lanta-PTT)
W88-11264

PROGRAMMING A HILLSLOPE WATER MOVEMENT MODEL ON THE MPP,
Science Applications Research, Lanham, MD.
For primary bibliographic entry see Field 2G.
W88-11265

8. ENGINEERING WORKS

8A. Structures

FOUNDATION DESIGN OF ANCHORED WALLS, BAY SPRINGS LOCK, MISSISSIPPI,
Army Engineer District, Nashville, TN.
M. D. Simmons, and F. W. Swartz.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 25, No. 2, p 185-205, May 1988. 11 fig, 5 tab, 9 ref, 3 append.

Descriptors: *Design criteria, *Foundation rocks, *Structural geology, *Locks, *Rock excavation, *Anchors, Bay Springs Lock, Tennessee Tombigbee Waterway, Rock properties, Mississippi.

Bay Springs Lock, the Northernmost structure on the Tennessee-Tombigbee Waterway, was designed for a normal lift of 84 ft. As a result of the high walls and relatively low strength of the foundation rock, deep and extensive excavations for necessarily large gravity wall monoliths would be required, with attendant high costs. To reduce these costs, an alternate design using anchored wall monoliths was proposed. Because this would be the first such design by the U.S. Army Corps of Engineers, a large test excavation and a great deal of subsurface exploration and laboratory testing was warranted. Since the rock mass would be an integral part of the lock walls, selection of realistic and reliable rock design parameters was critical. The geotechnical design included the selection of rock mass strengths, as well as the calculation of foundation settlement, bearing capacity and slope stability. Using the developed foundation data, the lock design was completed and the lock was constructed with the monoliths anchored to the rock mass with 116 tendons ranging in length from 80 ft to 175 ft. The project has been in operation for more than two years now and, to date, all indications are that it is functioning well. The load cells will continue to be monitored and, if necessary, any of the tendons will be restressed. (Author's abstract)
W88-10167

ESTIMATED PERFORMANCE OF TWITCHELL ISLAND LEVEE SYSTEM, SACRAMENTO-SAN JOAQUIN DELTA, UNDER MAXIMUM CREDIBLE EARTHQUAKE CONDITIONS,
California State Dept. of Water Resources, Los Angeles. Southern District.
M. O. Finch.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 25, No. 2, p 207-217, May 1988. 8 fig, 2 tab, 33 ref.

Descriptors: *Foundation failure, *Deltas, *Levees, *Seismology, *Earthquakes, *Geologic Fractures, Saline water intrusion, Twitchell Island Levee System, Sacramento-San Joaquin Delta, San Francisco Bay Area, Maximum Credible Earthquake, Simplified Liquefaction Procedure, Peat.

Studies have shown that levee failure in the Sacramento-San Joaquin Delta can lead to salt water contamination of one of California's most important surface sources of freshwater. This paper examines the seismic stability of one of the delta's largest levee systems for maintaining water quality: Twitchell Island Three Mile Slough levee. This levee will become unstable (factor of safety less than 1.00,) due to the low shear strength peat foundations beneath it, if the dead weight its suction-dredge placed sand toe berm is removed. The toe berm is highly susceptible to liquefaction from the Maximum Credible Earthquake accelerations of several nearby faults based on the Simplified Liquefaction Procedure and field data presented in this paper. The Maximum Credible Earthquake of several San Francisco Bay Area faults are capable of causing liquefaction of the toe berm and failure of the levee. A moderate earthquake of magnitude 6, centered within 14 miles of Twitchell Island, can also cause levee failure. Similarities between Twitchell Island and other delta islands suggest that the entire delta is vulnerable to even moderate earthquakes. (Author's abstract)
W88-10168

CORRELATION OF PIPELINE DAMAGE WITH GROUND MOTIONS,
Weidlinger Associates, Palo Alto, CA.
For primary bibliographic entry see Field 8E.
W88-10194

EXPERIENCE IN THE CONSTRUCTION AND OPERATION OF STEEL PRESSURE PIPELINES OF HYDROPOWER DEVELOPMENTS,
A. R. Freishist.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 123-134, September 1988. 10 fig, 4 ref. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 12-19, March 1987.

Descriptors: *Hydraulic structures, *Hydraulic machinery, *Pipelines, *Hydroelectric plants, *Pumped storage, Soviet Union, Hydraulic turbines, Construction, Engineering, Technology.

Steel pressure pipelines are the most metal-consuming constructions of hydraulic structures. Diversion, turbine, and sometimes discharge steel pipelines are widespread at hydroelectric and pumped-storage stations. They are made mainly in the form of free-lying steel pipes or in the form of steel shells embedded in concrete, rock, and reinforced-concrete (concrete encased steel pipelines). Individual cases of damages and even of failures of various kinds are encountered in Soviet practice of the construction and operation of pressure pipelines. Analogous cases are known also in other countries. This paper presents some examples of failures and damages in elements of pipelines that occurred in the postwar period. These examples of failures and damages of steel pipelines of various types indicate that among the causes of failure of metal structures, manufacturing and technological causes dominate: the use of defective materials, the wrong technology in manufacture and assembly, the low quality of welded joints, insufficiently rigorous inspection of the manufacturing process, and violation of construction specifications and regulations. There are practically no failures caused by design factors. This indicates that the static operation of pipelines of various types has been sufficiently well-studied, and the level of design is rather high. (Friedmann-PTT)
W88-10218

SOME PROBLEMS OF THE MANUFACTURING TECHNOLOGY OF MECHANICAL EQUIPMENT AND STEELWORK OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8C.
W88-10219

CONSTRUCTION OF GEODETIC NETWORKS FOR STUDYING CRUSTAL MOVEMENTS WHEN CREATING HYDRAULIC STRUCTURES IN SEISMIC REGIONS,
For primary bibliographic entry see Field 8E.
W88-10221

ON-SITE INVESTIGATIONS OF THE EFFECT OF EXTERNAL FORCES ON THE CONTACT ZONE OF THE BRATSK DAM,
V. N. Durcheva, and Z. I. Solov'eva.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 158-163, September 1987. 2 fig, 2 tab, 3 ref. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 35-38, March 1987.

Descriptors: *Dams, *Hydraulic structures, *Hydraulic engineering, *Stress, *Deformation, *Seepage, *Foundation rocks, Hydraulic design, Pressure distribution.

The Bratsk dam was the first dam in the history of Soviet hydraulic engineering in which opening of the contact joint under the upstream face and the phenomenon of decompression of the rock foundation were found. The original zone of decompression in the foundation occurs as a consequence of the occurrence of a zone of biaxial tension there. In this zone, the uplift increases due to a decrease of the seepage resistance, becoming an additional external force increasing the discontinuity of the foundation. Thus, uplift is simultaneously the cause of additional decompression and its effect. To determine the effect of uplift on the deformed state of the foundation, the hydraulics department of the Bratsk hydroelectric station conducted an experiment on two groups of sections with a different upper pool level (UPL). On-site data on the interrelation between strains of the contact plane and uplift pressure in a foundation with various degrees of decompression were obtained for the first time. Results of the experiment showed that different states of stress and strain of the foundation under the upstream face of the powerhouse and nonoverflow sections of the Bratsk dam determined the different diagrams of the uplift pressure. The seepage heads depend both on the UPL and on the season: the maximum uplift is observed in February-March at a UPL somewhat below the normal pool level (NPL) but with a maximum depth of the open joints on the downstream face. The effect of the uplift pressure on a change in the strained state of the contact zone consists in a direct relation between a decrease of the seepage heads and decrease of the tensile stresses or elongation in the region of the contact joint under the upstream face. (Friedmann-PTT)
W88-10223

LONG-TERM SERVICE CHECKING OF THE CONCRETE OF THE CHIRKEY DAM,
For primary bibliographic entry see Field 8F.
W88-10224

MONITORING WELL FILTER PACK AND SCREEN SLOT SELECTION: A REASSESSMENT OF DESIGN PARAMETERS,
T. E. Gass.
Water Well Journal WWJOA9, Vol. 42, No. 5, p 30-32, June 1988. 1 tab.

Descriptors: *Well filters, *Well screens, *Wells, *Well function, *Observation wells, Groundwater management, Geohydrology, Design criteria.

This article presents several alternative monitoring well designs that appear to work well in many, but not necessarily all, geologic environments. The well designs presented incorporate many of the concepts that can be found in the current draft of the ASTM Recommended Practices for the Design and Installation of Ground-Water Monitoring Wells in Aquifers. Well designs discussed include naturally developed monitoring wells, artificial filter-packed wells, and monitoring well design for low-permeability formations. (Friedmann-PTT)
W88-10243

DAM ACTIVITIES IN THE USA,
United States Committee on Large Dams, San Francisco, CA.
A. E. Wanket, and N. Smith.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 6, p 25-27, June 1988.

Descriptors: *Dams, *Dam construction, *Hydraulic engineering, *Hydraulic equipment, *Hydraulic design, *Construction methods, *Construction materials, Engineering, Hydraulic structures, Re-

views, Monitoring, Administrative agencies, Safety, Locks, Navigation, Automation, Data storage and retrieval, Concrete dams, Concrete construction, Concrete mixes, Cofferdams, Earth dams, Earthworks, Conferences, Cements, Portland cements, Earthquake engineering.

Current dam activities in the United States are reviewed in relation to the 21 study tours being organized by the 56th Executive Meeting and 16th Congress of the International Commission on Large Dams (ICOLD) to be held in June, 1988. These tours include visits to 65 dams. Topics discussed include new dams, dam safety, instrumentation and monitoring, and innovative design and construction techniques. New dams, both planned and underway, are described; although major new dam design and construction activity has slowed considerably, the construction of navigation locks and dams continues as the nation improves its inland navigation systems. Dam safety activities are concentrated in the areas of spillway adequacy, foundation and embankment seepage, and foundation and embankment seismic stability. Examples are provided of completely automated instrumentation systems; these systems generally cover seepage conditions, slope stability, stress/strain measurements, temperature, water pressure and levels, and seismic accelerations. Innovative design and construction techniques include the use of roller-compacted concrete, a unique cofferdam structure, spillway design improvements, foundation stability improvement efforts, silica fume additives to Portland cement concrete, and the use of reinforced earth for crest raising. (Doria-PTT)
W88-10393

APPLICATION OF A GEOMEMBRANE AT NIGERIA'S ISANLU DAM,
Babtie, Shaw and Morton, Glasgow (Scotland).
H. S. Eadie, and I. R. McGregor.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 6, p 28, 30-31, 33, June 1988. 6 fig, 2 ref.

Descriptors: *Membranes, *Dam design, *Nigeria, *Dam construction, *Isanlu Dam, *Construction materials, *Waterproofing, *Polymers, *Rockfill dams, Dams, Hydraulicstructures, Weirs, Engineering, Hydraulic engineering, Reservoirs, Grouting, Rock fill, Water supply development, Water resources development.

The design and construction aspects of the Isanlu dam are described. This dam is part of a $240 million project undertaken by the Biwater Group (UK) to improve water supplies to 64 towns and villages in Kwara State, Nigeria. As part of this project, an 18.6 m-high dam with a crest length of 120 m was constructed on the River Owa to provide an impounding reservoir for the Isanlu community. Because of a shortage of natural local materials to form the core of the dam, a high-density polyethylene membrane was used as the waterproof seal to this rockfill dam. The membrane was supplied by Schlegel GmbH of West Germany, who were also responsible for its laying and welding. Welding was carried out in the evening to achieve the minimum stress condition and no wrinkles at ambient service temperature. After the membrane was laid, it was recovered in the evening with a protective layer of sand. The main construction work was completed in just under a year, with the greater part of the bulk placing of rockfill being achieved in only four months from January to May, 1986. Impoundment commenced in August, 1986, and the reservoir reached capacity by October, 1986. (Author's abstract)
W88-10394

STRESSES AND CRACKS IN THE ROCK FOUNDATION OF AN EARTHFILL DAM,
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 8D.
W88-10395

COMPUTER MODELLING OF EMBANKMENT DAMS: RESPONSE TO EARTHQUAKE,
Motor-Columbus Ingenieurunternehmung A.G., Baden (Switzerland).
For primary bibliographic entry see Field 8D.
W88-10396

DESIGN OF SRI LANKA'S SAMANALAWEWA PROJECT,
Gibb (Alexander) and Partners, London (England).
P. A. A. Back, and J. R. Westwell.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 6, p 46-47, 49-50, June 1988. 5 fig, 2 tab.

Descriptors: *Sri Lanka, *Samanalawewa Project, *Rockfill dams, *Hydraulic design, *Hydroelectric plants, *Construction, Dam construction, Tunnel construction, Powerplants, Penstocks, Tunnels, Embankment dams, Dams, Grouting, Drainage, Spillways, Spillway gates, Reservoirs, Diversion structures, Electric power, Hydroelectric power, Electric power production, Walawe Ganga River, Electrical equipment.

The design of the Samanalawewa hydroelectric project on the Walawe Ganga (Sri Lanka) is described. The project consists of a 100 m-high embankment dam, a 5 km-long power tunnel, a steel penstock, and a surface power station with two 60-MW units. The dam, funded by Japan, will have a rockfill design with a central clay core to make optimum use of readily available materials. The main cofferdam forms an integral part of the embankment. A critical aspect of the embankment design will be the limitation and control of seepage through the karstified limestone foundation at the right abutment. The spillway, located at the left abutment, is of the gated overflow chute type, discharging into the river through a flip bucket. Two 6.8 m-diameter concrete-lined diversion tunnels have already been constructed. Impounding of the reservoir is planned for January 1, 1991. At a later stage, it is planned to double the size of the power plant and tap flow from a tributary which passes above the power tunnel near its downstream end. (Doria-PTT)
W88-10397

DAM CONSTRUCTION INCREASES WITH HYDRO EXPANSION IN ICELAND,
National Power Co., Reykjavik (Iceland).
P. Olafsson, and B. J. Bjornsson.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 6, p 66, 68, 70, 73-74, 77-78, June 1988. 9 fig, 2 tab.

Descriptors: *Iceland, *Dam construction, *Hydroelectric plants, *Dams, *Dam design, Hydroelectric power, Hydraulic structures, Lava, Conferences, Hydrology, Geology, Construction materials, Gravel, Earthworks, Dam foundations, Rockfill dams, Storage, Reservoirs, Grouting, Monitoring, Construction, Volcanoes.

Dam construction in Iceland in the past decades, to meet the expansion of the country's hydroelectric power system, is reviewed. Fourteen structures in Iceland are classified as large dams, and many of these will be visited by study tours during the 57th Executive Meeting of the International Commission on Large Dams in 1989. Special problems encountered in constructing dams on young lava flows are discussed. Most of the major dams built in Iceland during the past 20 years are on rather pervious post-Pleistocene lavas. Intensive instrumentation has been provided for monitoring the larger dams: groundwater levels are measured regularly, piezometric levels are automatically recorded, and an alarm system is activated in the event of abnormal changes. Precision levelling and surveys of lateral movements are carried out regularly. Construction techniques have changed during this period, with experience gained at previous sites being used in the design of subsequent dams. The Blanda project, presently under construction in North Iceland, includes three earth and rockfill dams. The Fljotsdalur scheme in East Iceland will be the largest in the country when completed. (Doria-PTT)
W88-10398

USE OF THE ROCK PRESERVATION SCALE IN GEOMECHANICAL INVESTIGATIONS AND CONSTRUCTION,
For primary bibliographic entry see Field 8E.
W88-10427

ENGINEERING-GEOLOGICAL SUBSTANTIATION OF THE DESIGNS OF UNDERGROUND HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8E.
W88-10428

SOME PROBLEMS OF IMPROVING GEOTECHNICAL INVESTIGATIONS FOR HYDROTECHNICAL CONSTRUCTION,
For primary bibliographic entry see Field 8D.
W88-10429

HORIZONTAL DISPLACEMENTS OF ROCK FOUNDATIONS OF DAMS,
For primary bibliographic entry see Field 8E.
W88-10431

ROLE OF SMALL HYDROELECTRIC STATIONS IN THE RATIONAL USE OF SMALL RIVERS,
For primary bibliographic entry see Field 4A.
W88-10433

PROBLEMS OF QUALITY CONTROL IN CONSTRUCTING EARTH DAMS,
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
For primary bibliographic entry see Field 8D.
W88-10579

WAYS TO REDUCE THE COST AND TIME OF CONSTRUCTING EARTH DAMS,
N. G. Savchenkov, and A. I. Kolesnichenko.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 257-262, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 14-18, May 1987. 1 fig.

Descriptors: *Dam construction, *Earth dams, *Cost-benefit analysis, *Civil engineering, Water resources development, Soil profiles, Soil compaction, Soil mechanics, Design criteria, Design standards, Electric powerplants, Hydroelectric power, Dams, Safety, Economic aspects, Construction.

On the basis of experience under the dangerous conditions at the Rogun site recommendations can be made for designing and constructing dams under similar conditions. When designing structures for hydro development safety considerations should be given weight equal to those of construction time and cost. It is necessary to begin considering safety at the outset of technical design. For example, if structures for diverting flow during construction (and the approaches to them) are located on the bank, and the transport roads are on the other bank of the powerhouse complex, then the situation can be avoided in which construction is taking place simultaneously at two sites, one of which is downslope from the other. Protection of structures which cannot be placed in a safe zone should be effected using concrete pens, retaining walls, cable bracing, or reinforcement of the slopes with sprayed concrete. Besides safety engineering, the paper discusses problems which were encountered and solved include the complex natural conditions at the construction site, complexity of the layout and individual structures, characteristics of the main borrow pits, and preparation of the canyon walls. The technology of constructing the dam, especially the core of the dam, is emphasized. (Author's abstract)
W88-10580

ENGINEERING THEORY OF SLIDE PROCESSES IN THE DESIGN OF EARTH DAMS ON A SOFT GROUND FOUNDATION,
For primary bibliographic entry see Field 8D.
W88-10581

INCREASE OF THE EFFECTIVENESS OF SAFETY CONTROL OF HYDRAULIC STRUCTURES UNDER PRESSURE,
A. I. Tsarev, I. F. Blinov, and F. G. Enikeev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 268-272, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 22-25, May 1987. 7 ref.

Descriptors: *Construction, *Dams, *Safety, *Hydraulic equipment, *Design criteria, Design standards, Hydrodynamics, Measuring instruments, Technology transfer, Water resources development, Electric powerplants, Russia.

In Russia the reliability of structures is evaluated in conformity with the Construction Specifications and Regulations (SNiPs), which also decree the mandatory equipping of hydraulic structures with monitoring and measuring equipment (MME) for checking the safety of their operation. The use of maximum allowable indices for control on-site observations at a number of hydrostations shows the possibility of substantially increasing the effectiveness of safety control in the operation of the structures. It is recommended that methods of determining the maximum allowable indices of the condition of hydraulic structures during design and methods of correcting them during service be included in the SNiPs. (Alexander-PTT)
W88-10582

STRESS-STRAIN STATE, SEEPAGE STRENGTH, STABILITY, AND OPTIMIZATION OF EARTH DAMS,
For primary bibliographic entry see Field 8D.
W88-10583

COMBINED DIVERSION AND SERVICE TUNNEL SPILLWAY OF THE TASHKUMYR HYDROELECTRIC STATION,
V. F. Ilyushin, E. V. Kurakina, and S. P. Reznikova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 282-289, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 31-36, May 1987. 6 fig, 3 ref.

Descriptors: *Diversion structures, *Tunnels, *Hydroelectric plants, *Spillways, *Construction, *Earth dams, Quality control, Soil compaction, Soil profiles, Soil mechanics, Civil engineering, Water resources development, Design criteria, Technology transfer, Design standards, Electric powerplants, Hydroelectric power, Dams, Tashkumyr hydroelectric station.

The Tashkumyr hydroelectric station with a capacity of 450 MW is being constructed on the Naryn River in Kirgizia as part of the series of Toktogul hydroelectric stations. At the Tashkumyr hydrostation the Naryn River flows in a narrow mountain valley (channel width 50-80 m) expanding downstream of the hydro development into the Fergana valley. The designed diversion-service spillway with the combined functions of a diversion tunnel during construction and a spillway during service made it possible to eliminate the construction of a temporary tunnel and, thanks to this, to save about 4 million rubles. The existence of a developed design of the gate equipment for the diversion tunnels of the Rogun Hydrostation served as the prototype of the tower intake with three intake openings at the Tashkumyr hydrostation. A lightweight drained lining bolted to the rock and operating with the use of the load-bearing properties of the rock mass is used in the tunnel part of the spillway in relatively undisturbed rocks. The design of the anchor-grout cutoff is reliable in undisturbed rocks. In tectonic crush zones it is necessary to provide for other designs to protect the end structures of spillways from undercutting or to use additional measures along with the anchor-grout cutoff. (Alexander-PTT)
W88-10585

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: I. INTRODUCTION,
Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
For primary bibliographic entry see Field 2H.
W88-10612

DIMENSIONLESS ANALYTICAL SOLUTIONS FOR DAM-BREACH EROSION,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and C. A. Quiroga.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 179-197, 1988. 9 fig, 4 tab, 8 ref.

Descriptors: Earth dams, *Dam failure, *Dams, *Erosion, Model studies, Simulation, Flow, Friction, Mathematical analysis.

Earthen dam breach erosion is analyzed using dimensionless analytical solutions, with rectangular and triangular representations for the breach section. Data for the historical failures of the South Fork and Teton Dams are used to test these solutions. A comparison with the Breach Erosion of Earthfill Dams (BEED) model shows the usefulness of these solutions. The closed form dimensionless analytical solutions for higher values of n were found to properly simulate dam breach erosion. Estimates of breach formation time, based on the dimensionless solutions, were found to be highly dependent on the empirical erodibility factor. However, peak discharge did not appear to be sensitive to this factor. This tendency coincides with the influence that Chezy's friction factor has on the BEED model and indicates the need to accurately measure the effects of friction on rapidly changing flow. A triangular breach section was shown to provide a better simulation of breach evolution than rectangular section. (Alexander-PTT)
W88-10765

SIMULATED MOTION OF A LOOSE REVETMENT BLOCK,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8D.
W88-10766

CUMBERLAND SMALL HYDRO SCHEME COMPLETED IN THE WEST INDIES,
Shawinigan Engineering Co. Ltd., Montreal (Quebec).
For primary bibliographic entry see Field 8C.
W88-10862

RIABA MINI HYDRO SCHEME IN EQUATORIAL GUINEA,
Electricite de France, Paris.
For primary bibliographic entry see Field 8C.
W88-10863

DESIGN ASPECTS OF THE CASTEL MONTECCHIO PLANT IN ITALY,
Studio Associato di Ingegnaria, Brescia (Italy).
For primary bibliographic entry see Field 8C.
W88-10865

STANDARDIZATION AND LAYOUT OF THE RIVER MURZ CASCADE SCHEME,
Krauss (Dr.) Consulting Engineers, Graz (Austria).
H. Krauss, and E. Burger-Ringer.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 7, p 26-31, July 1988. 5 fig, 1 tab.

Descriptors: *Austria, *Water resources development, *River Murz, *Hydroelectric power, *Hydroelectric plants, *Design criteria, Construction, Standardization, Planning, Engineering, Austria, Electric power, Environmental impacts, Cascades, Run-of-river plants.

In total, 27 small hydro sites have been identified on the River Murz in Austria. To date, 11 plants are in operation, four are under construction, seven more are under consideration, and studies are being carried out on the remaining five. The capacities of the individual run-of-river plants range from 0.5 to 2 MW, and the combined generation of the completed cascade scheme would be 133.25 GWh/year. The authors comment on 18 of these projects in which they are directly involved, and devote particular attention to environmental impact and the standardization of the equipment and civil works. (Author's abstract)
W88-10866

OUTLINE OF AN EARTH SLOPE IN THE WATERLINE PART OF LARGE CANALS AND RESERVOIRS,
For primary bibliographic entry see Field 8D.
W88-10875

COMBINATION OF MATHEMATICAL AND HYDRAULIC MODELING METHODS WHEN ANALYZING UNSTEADY REGIMES IN CANALS,
For primary bibliographic entry see Field 8B.
W88-10876

HYDRAULIC INVESTIGATIONS OF RUBBLE DRAINS,
For primary bibliographic entry see Field 8B.
W88-10877

LEAN ROLLCRETE FOR DAMS,
For primary bibliographic entry see Field 8F.
W88-10878

EARTH OVERFLOW DAM,
A. P. Miller, Y. P. Pravdivets, and V. A. Salov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 503-507, February 1988. 4 fig, 5 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 49-52, August 1987.

Descriptors: *Hydraulic structures, *Earth dams, *Hydraulic engineering, *Hydraulic design, *Construction, Dams, Economic aspects, Planning, Geohydrology, Concretes, Costs, Soviet Union, Revetments.

A new water-lift structure and intake in the USSR is of the earth overflow type. River characteristics, engineering-geological and hydrogeological conditions of the site, metamorphic and intrusive formations and site (trans-Baikal region, Soviet Union) sedimentary deposits, and composition for the hydro development are described. Examination shows that earth overflow dams with protection of the surfaces by a precast reinforced-concrete revetment consisting of wedgeshaped elements may be less than half as expensive as a concrete overflow dam. the examined type of dam permits maximum use of local construction materials, soils, and the industrially manufactured revetment elements provide independence of the construction of the structure from climatic conditions. (Friedmann-PTT)
W88-10879

WAVE MOTION IN POOLS OF MOUNTAIN HYDRO DEVELOPMENTS,
For primary bibliographic entry see Field 8B.
W88-10881

HYDRODYNAMIC LOADS ON AN APRON WITH CAVITATING DISSIPATORS,
For primary bibliographic entry see Field 8B.
W88-10882

CALCULATION OF THE POSITION OF THE FREE WATER SURFACE ON A BEND OF A FREE-FLOW TUNNEL,
For primary bibliographic entry see Field 8B.
W88-10883

METHODS OF HYDRAULIC CALCULATION OF BAFFLE WALLS AND STILLING BASINS,
For primary bibliographic entry see Field 8B.
W88-10884

HYDRAULIC RESISTANCES OF LARGE UNLINED CANALS IN NONCOHESIVE SOILS,
For primary bibliographic entry see Field 8B.
W88-10885

PASSAGE OF DIVERSION AND SERVICE FLOW DURING CONSTRUCTION OF EARTH DAMS,
Y. A. Grigor'ev, G. L. Rubinshtein, and V. M. Semenkov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 470-477, February 1988. 5 fig, 6 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 21-26, August 1987.

Descriptors: *Dam construction, *Diversion structures, *Earth dams, *Dams, *Hydraulic structures, *Hydroelectric plants, Soviet Union, Spillways, Canals, Pipes, Economic aspects.

Analyzing the experience in discharging diversion flows when constructing Soviet hydro developments, noted that, in the overwhelming majority of cases, diversion spillways located in concrete structures were used. These spillways were, along with earth dams, incorporated into the impounding barrier of the hydro development. An analysis shows that tunnel spillways, canals, and pipes were used most often in the layouts of hydro developments with earth dams for passage of the flows during construction. Reequipping the diversion spillways into service spillways or power conduits was provided for to reduce the share of the cost for passage of diversion flow. The development of economical schemes of releasing construction discharges earth dams on large rivers should become the leading task of scientific research on outlet works of hydro developments. (Friedmann-PTT)
W88-10886

IMPROVEMENT OF HYBRID MODELING,
For primary bibliographic entry see Field 8B.
W88-10887

THREE-DIMENSIONAL FREE AND MOVING BOUNDARY SEEPAGE PROBLEMS SOLVED USING AN INTEGRAL TRANSFORMATION IN A FIXED DOMAIN METHOD,
California Univ., Santa Barbara.
For primary bibliographic entry see Field 2F.
W88-10941

WELL CONSTRUCTION TECHNIQUES TO PREVENT INTERAQUIFIER MOVEMENT OF PESTICIDES,
CH2M Hill, Tampa, FL.
M. B. McNeal, and J. C. Miller.
IN: Proceedings of the Focus Conference on Southeastern Ground Water Issues. National Water Well Association, Dublin, OH. 1986. p 44-56, 4 fig, 9 ref.

Descriptors: *Florida, *Water pollution control, *Water supply development, *Well construction, *Drilling, *Potable water, *Groundwater pollution, Aquifer systems, Aquifer management, Wells, Pesticides, Fumigants, Ethylene dibromide, Nematodes.

The use of ethylene dibromide (EDB) as a nematicide in the soybean and peanut-producing counties of Northern Florida, and citrus-producing counties of Central Florida, has contaminated portions of the potable groundwater in these areas. For this reason, alternate sources of potable water must be located and developed. The Florida Department of Environmental Regulation implemented a number of projects to determine the behavior of EDB in soils and groundwater. In one such project in Jackson County, an exploratory well was drilled to determine the extent of deeper EDB contamination present in the Floridan aquifer and to determine if the lower (Claiborne) aquifer could be a source of uncontaminated potable water. Three different methods of drilling were used with a series of four telescoping casings pressure-grouted in place. An optimum length of 458 feet was drilled, with 125 feet of 4-inch stainless steel screen placed at the various water-producing depths. Geophysical water level monitoring and proper discharge of drilling fluids helped provide proper well construction for the results desired. The confining zone separating the contaminated Floridan aquifer from the deeper uncontaminated Claiborne aquifer is preventing downward migration of EDB. With proper well construction techniques, public supply wells can be drilled without resulting in pesticide related contaminants following a path along the well annulus to uncontaminated water-producing zones. (See also W88-11084) (Miller-PTT)
W88-11089

IMPACT UPON PRESSURE HEAD WHEN WELLS PENETRATE MULTIPLE BASALT AQUIFERS NEAR MOSIER, OREGON,
Oregon State Water Resources Dept., Salem. Ground Water Div.
For primary bibliographic entry see Field 2F.
W88-11134

OLD RIVER CONTROL AUXILIARY STRUCTURE: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W88-11278

MUDDY CREEK GRADE CONTROL STRUCTURES, MUDDY CREEK, MISSISSIPPI AND TENNESSEE: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
C. H. Tate.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report No. HL-88-11, May 1988. Final Report. 58 p, 7 fig, 1 tab, 16 photos, 15 plates.

Descriptors: *Muddy Creek, *Mississippi, *Tennessee, *Hydraulic models, *Scour, *Hydraulic structures, Model studies, Riprap, Scour, Flow profiles, Channel erosion, Baffles.

Riprap grade control structures were installed at 12 locations along the Muddy Creek drainage system between September 1976 and September 1983 by the U.S. Soil Conservation Service. After scour holes formed immediately downstream of the first four structures, the exit transition of the structure design was changed from a 1:4 exit flare to a 1:8 exit flare. Many of the redesigned structures formed scour holes after completion. The U.S. Army Engineer Waterways Experiment Station used a 1:16-scale model and a 1:24-scale model to study the scour problem and design modifications to the existing structures. Scour was caused by uneven flow distribution due to flow separation in the exit flare. A series of H-pile baffles were designed for the 1:8 and 1:4 exit flares. Additional studies determined that a 1:16 exit flare with no baffles prevented flow separation within the exit transition resulting in a uniform distribution of flow downstream of the grade control structure. (Author's abstract)
W88-11283

8B. Hydraulics

FIELD EVIDENCE FOR HYDRAULIC JUMPS IN SUBAQUEOUS SEDIMENT GRAVITY FLOWS,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W88-10159

TURBULENT BOUNDARY LAYERS IN VERTICAL CURVES,
Nanjing Hydrological Research Inst. (China).
S. Jiang.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 783-797, July 1988. 10 fig, 13 ref, appen.

Descriptors: *Turbulent flow, *Hydraulics, *Spillways, *Outlet channels, *Hydraulic structures, *Cavitation, *Flow friction, *Channel flow, *Boundary layers, Hydrodynamics, Outlets, Flow pattern, Fluid mechanics, Model studies, Mathematical equations.

Cavitation damage is often observed near the downstream end of the flip buckets of many high-head outlet works. To analyze and mitigate the problem, many research efforts now focus on the development of the boundary layer along the bucket surface. In this paper, the centrifugal-force effect on flow characteristics over a bucket is discussed. The boundary-layer momentum and energy integral equations are derived by incorporating the effect of the bucket curvature. The surface shear stresses are calculated based on the theory of wall layers. The turbulent boundary-layer thickness and the exponential velocity distribution are obtained by applying the finite-difference method. It was found that higher velocity occurs near the bucket surface throughout its entire length, and the skin-friction coefficient increases significantly in the downstream half of the bucket. The cavitation inception number approaches its maximum value at the end of the bucket, and, therefore, cavitation damage is most likely to occur near the downstream end of the flip bucket of high-head outlet works. (Author's abstract)
W88-10233

SCOUR DOWNSTREAM OF VERTICAL GATE,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
A. Uyumaz.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 7, p 811-816, July 1988. 4 fig, 1 tab, 12 ref.

Descriptors: *Hydraulics, *Stream erosion, *Flow discharge, *Scour, *Sluice gates, *Hydraulic structures, Model studies, Fluid mechanics, Hydraulic properties, Hydraulic models.

The rate of scour behind a sluice gate depends upon the discharge through the gate. There is a limit to the extent of scour that is approached asymptotically. After a certain time, the depth of scour remains constant. A model study has been conducted to investigate the scour phenomenon when water flows simultaneously under and over a movable vertical gate. It was found experimentally that the final depth of scour is smaller when there is simultaneous flow under and over the gate, as compared to the cases of flow only under or over the gate, although more water can be discharged in the former case. This shows that the overtopping of a sluice gate is not dangerous from the point of view of downstream scour. (Friedmann-PTT)
W88-10236

ANALYTICAL SOLUTION OF CHANNEL FLOW MODEL WITH DOWNSTREAM CONTROL,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
For primary bibliographic entry see Field 2E.
W88-10401

LAMELLA SETTLERS: MATERIAL BALANCES AND CLARIFICATION RATES,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5D.
W88-10407

CHARACTERISTICS OF THE ICE AND THERMAL REGIMES OF HYDROELECTRIC STATIONS AND PUMPED-STORAGE STATIONS,
Y. A. Gotlib.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 91-95, August 1987. 17 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 36-39, February 1987.

Descriptors: *Hydroelectric plants, *Rivers, *Ice formation, *Ice jams, *Foreign construction, *Hydrothermal studies, *Pumped storage, Cold weather construction, Permafrost, Talik, Maximum flow,

River mechanics, Soviet Union, Temperature, Design criteria.

A study of the hydrological regime is being undertaken at the All-Union Planning, Surveying, and Scientific-Research Institute (Gidroproekt). More than 300 sites for observation of the regime of rivers are used, and special investigations of hydraulic conditions, thermal and ice regimes, and fluvial processes are carried out at many hydroelectric stations which are operating, being planned, and under construction. As a result of constructing cascades of hydroelectric stations (HES) on many Soviet rivers, their hydrological regimes have changed substantially. Examples of ice difficulties in two areas near HES are detailed. A number of hydro developments are being designed, constructed, and operated in the permafrost zone. The thermal regime of reservoirs on permafrost should be examined by observations on permanent verticals and thermal sections. Resulting data would aid in layout of the structure, site selection of intake and outlets, prediction of talik (permanently unfrozen ground) occurring around hydraulic structures, and reworking of the banks of the reservoirs. Determination of the maximum discharges of rivers with a multiple flood regime in the Siberia and the Far East is another important factor needed for designing. Further development of investigations of the hydrological, ice and thermal regimes of HESs and pumped storage stations will enable a wider check of design assumptions, use of the method of analogy, and determination of the parameters of these regimes with a greater accuracy, which will improve the completeness and reliability of hydrological substantiation of designs. (VerNooy-PTT)
W88-10430

SEDIMENT TRANSPORT IN A CURVED CHANNEL,
V. S. Altunin, L. V. Larinova, A. T. Martinkus, and N. M. Novikova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 290-294, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 37-40, May 1987. 4 fig, 1 tab, 4 ref.

Descriptors: *Hydraulics, *Sedimentation, *Channel erosion, *Curved channels, *Hydrodynamics, *Sediment transport, Suspended sediments, Design criteria, Design standards, Civil engineering, Construction.

When calculating deformations (erosion and siltation) of channels composed by easily erodible (sand) soils, one of the main characteristics is the transport capacity of the flow. The amount of sediments that a flow can transport depends on the ratio of average flow velocity to the noneroding velocity. Sediments are divided into suspended and bed loads, and in suspended sediments are distinguished bed material, which mainly moves in the bottom region and participates in the channel-formation process, and wash load, which under certain hydraulic conditions of the flow moves in a suspended state. Bed-load discharge in a curved channel (with curvature of the channel line and parallel banks) considerably increases compared with a straight channel, and the more so, the greater the average flow to noneroding velocity ratio. The hydraulic resistances in the experiments with a curved channel increase insignificantly compared with a straight channel (the Chezy coefficients in the experiments with the curved channel line decrease by 5-12%). (Alexander-PTT)
W88-10586

CALCULATION OF THE TURBULENT BOUNDARY LAYER IN THE INITIAL SECTION OF PIPE,
A. M. Temirkhanov, and V. M. Spivak.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 294-296, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 40-41, May 1987. 1 fig, 4 ref.

Descriptors: *Hydraulics, *Hydrodynamics, *Turbulent flow, *Boundary layers, *Pipe flow, Pipes, Velocity, Friction, Model studies, Statistical methods, Mathematical studies, Design criteria, Design standards, Civil engineering, Equations.

The method of calculating the turbulent boundary layer in the initial section of a pipe is simplified if one proceeds from a power distribution of the velocities in the boundary layer. The relation between the exponent n and the hydraulic friction coefficient for a developed turbulent flow lambda in the form n equals the square root of lambda with consideration of the real (experimental) variation of eddy viscosity over the cross-section of the flow is somewhat refined and for all resistance regimes is written as n equals 0.95 times the square root of lambda. The new equations compare favorably with older versions. (Alexander-PTT)
W88-10587

DIFFUSIVE LIMIT FOR ENTRAINMENT,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
J. F. Atkinson, and D. R. Munoz.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 117-130, 1988. 7 fig, 3 tab, 22 ref. NSF Grant MSM-8505333.

Descriptors: *Diffusion, *Kinetics, *Entrainment, *Hydrodynamics, Model studies, Mathematical studies, Saline-freshwater interfaces, Design standards, Design criteria, Equations.

An entrainment model is developed which includes the effect of the buoyancy flux by molecular diffusion across a density interface. This effect is incorporated into the conservation equation for turbulent kinetic energy through a 'diffusion parameter' derived from the bulk Richardson number and the Peclet number. As increases and approaches a critical limiting value the net entrainment, defined as the rate of deepening of the mixed layer, becomes zero. Based on a numerical study and on results from two experiments of different scales, it is shown that the limiting value of this parameter for entrainment to occur is approximately 10 for a salt-stratified system, though this value may depend on the diffusivity of the stratified component. (Author's abstract)
W88-10763

WATER POWER WITHOUT WATERFALLS,
Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Lucas Heights Research Labs.
For primary bibliographic entry see Field 8C.
W88-10867

EFFECT OF UNSTEADINESS ON REYNOLDS STRESSES OF ACCELERATED PIPE FLOWS,
U. R. Liiv, and R. Y. Ruubel.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 482-486, February 1988. 8 fig, 8 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 30-33, August 1987.

Descriptors: *Hydraulic systems, *Stress analysis, *Unsteady flow, *Reynolds stresses, *Pipe flow, Pump storage, Pipes, Model studies, Stability, Computer programs.

An experimental evaluation was conducted of the effect of unsteadiness on Reynolds stresses during acceleration of a fluid from a state of rest in pressure pipelines. The experimental device equipped with a measuring complex made it possible to automate the experiment and store and processed the experimental data in real time. Software created in the laboratory for the measuring complex consists of HDISA for selecting, in real time, the initial parameters for the experiment, and the WORK package for working with the stored data. The investigation showed that during acceleration of a fluid, protraction of the occurrence and suppression of eddy stresses occur, as a consequence of which the use of the quasisteady approach for determining the values of the Reynolds stresses is not valid. (Friedmann-PTT)
W88-10873

SPIRAL EDDY AT THE INTERFACE OF TWO LIQUID LAYERS WITH DIFFERENT DENSITIES,
N. A. Ivanov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 486-487, February 1988. 1 fig. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 34, August 1987.

Descriptors: *Eddies, *Fluid mechanics, *Hydrodynamics, *Density stratification, Path of pollutants, Fluid flow, Physical properties, Rotational flow, Stratification, Self-organization, Thermal stratification, Chemical stratification.

While conducting physical experiments with a density-stratified liquid, formation of a spiral eddy at the interface of liquids with different densities was observed. Density differences between the two water layers were achieved either by heating the upper layer relative to the lower one or by adding table salt to the lower layer. This phenomenon is an example of self-organization of a system, the occurrence of spiral structure from chaos. Both cyclonic and anticyclonic rotation was observed, depending on the thickness of the upper and lower layers. It is necessary to take into account this effect in large stratified water bodies when modeling the spread of pollutants in the thermocline. (Friedmann-PTT)
W88-10874

COMBINATION OF MATHEMATICAL AND HYDRAULIC MODELING METHODS WHEN ANALYZING UNSTEADY REGIMES IN CANALS,
N. P. Bestuzheva.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 493-497, February 1988. 5 fig, 3 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 38-41, August 1987.

Descriptors: *Unsteady flow, *Intakes, *Hydroelectric plants, *Hydraulic design, *Hydraulic models, *Channel flow, Hydraulic engineering, Flow velocity, Hydraulic gates, Intake gates, Turbines, Saint Venant equations, Mathematical models, Design criteria, Water level, Waves.

If the delivery of water into a headwater channel of a diversion hydroelectric station is regulated by gated headworks, then the hydraulic regime in it is formed by the effects caused by operations of the turbines and gates. It is necessary to determine the maximum increase in the water level and rapidity of its change, flow velocity, and travel speed of the wave both for assigning the main dimensions, revetment, and equipment of the channel and for developing a system controlling water delivery along it. This investigation shows that in a hydraulic substantiation of the design of channels conveying water to the intakes of diversion hydrostations and having a considerable length and headworks regulation at a gated intake, satisfactory results can be obtained from the combined use of mathematical and hydraulic models. The final goal of using the mathematical model is to check, on the basis of the allowable values of the hydraulic parameters at control sections, the design proposals on selecting the canal cross sections and to find the optimal agreement of the schedules of operating the intake gates with the operating regimes of the turbines, i.e., to develop the basic principles for creating an appropriate automatic control system. For this purpose, the model of unsteady flow based on one-dimensional Saint Venant equations is sufficient. (Friedmann-PTT)
W88-10876

HYDRAULIC INVESTIGATIONS OF RUBBLE DRAINS,
V. I. Shtykov, and S. G. Gordienko.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 497-498, February 1988. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 41-42, August 1987.

Descriptors: *Rubble drains, *Drains, *Hydraulic structures, *Hydraulic engineering, *Hydraulic design, *Fluid flow, *Trenches, Porous media, Seepage, Model studies, Hydraulic models.

A drain in which the water-draining trench in the ground is filled with coarse-granular material is

called a rubble drain. For a hydraulic calculation of a rubble drain, it is necessary to know the regularity of the flow of water in the pores of the filling. Proceeding from a premise of the description of fluid flow in porous media, a model of the filling in the form of a set of seepage passages with curvilinear axes of periodic outline was employed. The applicability of the model of the seepage passages to a description of the flow of water in coarse-granular materials for any seepage flow regime was substantiated theoretically and experimentally. On the basis of the two-term formula of resistance, for seepage in coarse-grained materials relations were obtained for calculating rubble drains for laminar, transition, and turbulent flow regimes in them. (Friedmann-PTT)
W88-10877

WAVE MOTION IN POOLS OF MOUNTAIN HYDRO DEVELOPMENTS,
N. B. Kereselidze, and I. D. Muzaev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 456-458, February 1988. 2 fig, 5 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 11-12, August 1987.

Descriptors: *Wave propagation, *Wave velocity, *Mathematical studies, *Reservoirs, Differential equations, Hydrodynamics, Avalanches, Landslides, Mudflows, Mathematical equations, Soviet Union, Design criteria, Hydroelectric plants, Boundary conditions, Hydraulic structures, Mountain lakes.

In the practice of design and operation of mountain hydraulic structures, it is often necessary to examine problems related to wave motion in the pools of mountain hydro developments representing narrow nonprismatic canyons (for example, wave motion in the case of intrusion of landslides, mudflow, or avalanches into the reservoir). To develop a method of calculating wave motion in narrow but deep nonprismatic water bodies, a system of Euler differential equations, having average only over the transverse coordinate y was employed. The method was employed with the problem of wave formation in the Zaramag Hydroelectric Station reservoir (Soviet Union), where an area of landslide potential exists along one wall of the reservoir. The boundary-value problem was solved by using methods of operational calculus. The equation of the wave surface is obtained in the form of a convergent trigonometric series. Approximate calculations show that the maximum increase of the water level near the dam from the normal pool level is about 7 m. (Friedmann-PTT)
W88-10881

HYDRODYNAMIC LOADS ON AN APRON WITH CAVITATING DISSIPATORS,
N. P. Rozanov, and B. M. Obidov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 458-460, February 1988. 2 fig, 5 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 12-13, August 1987.

Descriptors: *Cavitation, *Hydraulic structures, *Hydrodynamics, *Energy dissipation, *Hydraulic engineering, Dissipators, Aprons, Spillways, Costs, Design criteria, Construction, Stability.

Data on the vertical and horizontal mean fluctuation loads on dissipators and the apron platform were obtained for several types of erosionless energy dissipators, which makes it possible to perform the required calculations of the strength and stability of structural elements in the lower pool. The investigations showed that despite some decrease in the energy-dissipating ability of the dissipators in the presence of developed cavitation (decrease of C sub x) and increase of the fluctuation effects of the flow on the dissipators and apron in the case of cavitation of the dissipators, under appropriate conditions they are efficient, providing favorable operating regimes of the lower pool and reducing the volume of construction works and costs of the structure. (Friedmann-PTT)
W88-10882

CALCULATION OF THE POSITION OF THE FREE WATER SURFACE ON A BEND OF A FREE-FLOW TUNNEL,
S. M. Slisskii, and I. A. Kalandarov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 460-465, February 1988. 4 fig, 4 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 14-17, August 1987.

Descriptors: *Fluid mechanics, *Pipe flow, *Tunnels, *Hydrodynamics, *Surface waters, *Fluid flow, Hydraulic systems, Hydraulic structures, Spillways, Tunnels, Cavitation, Flow velocity, Hydroelectric plants, Design criteria, Soviet Union.

Calculation of the position of the free water surface on a bend of a free-flow tunnel and of the distribution of pressure and velocities makes it possible to determine the internal load on the lining, to preduct cavitation, and to effectively arrange, in the lining, the openings of drain wells and inlets of transverse channels intended for aeration of the wall-boundary region to combat cavitation erosion. A section of bend along the arc of a circle of a spillway tunnel is examined. Such a tunnel is being constructed, for example, as part of the Kambraty No. 2 hydroelectric station (USSR). The limitations of the angles of bend of a tunnel route, radius of curvature, and velocity set by the Building Code SNiP 2.06.09-84 are given regardless of the form of flow (free pressure). This should be reexamined, since in the case of a free flow, flow separation of the through-going flow from solid boundaries is accompanied by a drop of the capacity, a drop of pressure in the zone of separation, and by an increase of dynamic loads. (Friedmann-PTT)
W88-10883

METHODS OF HYDRAULIC CALCULATION OF BAFFLE WALLS AND STILLING BASINS,
T. P. Provorova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 465-466, February 1988. 1 fig, 4 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 17-18, August 1987.

Descriptors: *Baffles, *Hydraulic structures, *Hydraulic engineering, *Hydraulic design, *Energy dissipation, Stilling basins, Walls, Mathematical studies, Design criteria, Hydraulic jump.

Baffle walls and stilling basins are some of the most simple and effective energy dissipators. Approximate theoretical methods of calculating the heights of the walls and depths of the basins with and without consideration of the reaction of the dissipator are well-known. For choosing the methods of calculating dissipators, available experimental data were compared and wall heights and basin depths were calculated with the use of the main approximate theoretical solutions. The results of the calculation by different methods differed among themselves. Relations between elements of the jump and energy dissipator, simplifying calculation of dissipators, were established on the basis of supporting experimental data. The relations were obtained for a rather broad range of variation of the parameters of the dissipator and jump. (Friedmann-PTT)
W88-10884

HYDRAULIC RESISTANCES OF LARGE UNLINED CANALS IN NONCOHESIVE SOILS,
V. S. Altunin, and L. V. Larinova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 466-470, February 1988. 4 fig, 2 tab, 4 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 18-21, August 1987.

Descriptors: *Channel flow, *Irrigation canals, *Canals, *Roughness coefficient, Climate, Geohydrology, Drag, Fluid flow, Soil water, Flow velocity, Hydraulic gradient, Hydraulic structures, Hydraulic engineering, Soviet Union.

About 60 large (with discharges of more than 100 cu m/sec) unlined irrigation canals passing in zones with various climatic and geological conditions are presently operating in the Soviet Union. The roughness coefficient n employed in most relations for the Chezy coefficient C is considered to be an integral characteristic of the channel roughness, taking into account both granular roughness and macroroughness. To avoid indeterminacy, numerous investigations are being conducted both to find regularities of changes in the roughness coefficients and to obtain relations for C (or lambda) without n. The hydraulic resistances of a large unlined canal in noncohesive soils (for conditions of a clarified flow) are determined by the uniqueness of the hydraulic regime during establishment of relative stabilization of all main elements of the flow and channel. The use of the kinematic index x, characterizing the rate of change in velocities vertically, and being a function of the hydraulic resistances, as a criterion of the mobility of bed forms, makes it possible to estimate the state of stability of dune forms on various stretches of a large irrigation canal running in an earth channel. An arbitrary assignment of the roughness coefficients n is impermissible when determining hydraulic resistances and longitudinal gradients of a large unlined canal with channel-forming elements. The hydraulic gradients providing longitudinal stability of a straight channel can be predicted both by the traditional method (in terms of n), but with consideration of the regular variability of n and on the basis of the established relationship between hydraulic resistances and the channel shape parameter. (Friedmann-PTT)
W88-10885

IMPROVEMENT OF HYBRID MODELING,
G. V. Vasil'chenko.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 477-482, February 1988. 2 fig, 8 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 27-30, August 1987.

Descriptors: *Hydraulic models, *Hydraulic engineering, *Mathematical models, *Differential equations, Fluid flow, Model studies, Hybrid models, Flow velocity, Reynolds equations, Curvilinear coordinates.

The problem of improving the reliability of the solution of applied problems of hydraulics engineering on the basis of combining analytical solutions and hydraulic experiments continues to be discussed. One of the Reynolds differential equations transformed to an orthogonal curvilinear coordinate system, which relates the components of the velocity vector to a longitudinal pressure drop in the case of a two-dimension uniform flow is discussed and examples are presented of the solutions applied to improvement of hybrid modeling. The use of curvilinear coordinates and Reynolds differential equations makes it possible, in a number of cases, to calculate the characteristics of two-dimensional fluid flows and on this basis, to improve hybrid modeling for increasing the reliability of solving practical problems. (Friedmann-PTT)
W88-10887

BEDLOAD TRANSPORT IN GRAVEL CHANNELS,
McGill Univ., Montreal (Quebec). Dept. of Physical Geography.
For primary bibliographic entry see Field 2J.
W88-11028

APPLICATION OF CONCEPTS OF ENGINEERING TO AN UNUSUAL HYDROLOGIC PROBLEM: THE STORMWATER DRAINAGE WELLS OF ORLANDO, FLORIDA,
University of Central Florida, Orlando.
For primary bibliographic entry see Field 2F.
W88-11095

AERATION AT OVERFLOW WEIRS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5G.
W88-11269

OLD RIVER CONTROL AUXILIARY STRUCTURE: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. P. Fletcher, and P. Bhramayana.
Available from the National Technical Information Service, Springfield, VA. 22161, as ADA-142221. Price codes: A04 in paper copy; A01 in microfiche. Technical Report No. HL-88-14, June 1988. Final Report. 109 p, 7 fig, 6 tab, 18 photos, 69 plates.

Descriptors: *Old River, *Hydraulic models, *Model studies, *Hydraulic structures, Spillways, Riprap, Channel flow, Flow profiles, Flow patterns, Louisiana, River training, Hydraulic profiles.

Model tests of the Old River Control Auxiliary Structure (Louisiana) were conducted to investigate and develop a design that would provide satisfactory flow characteristics in the approach channel, at the abutments, over the spillway, in the stilling basin, and in the exit channel, and determine the adequacy of the riprap protection proposed for the approach and exit channels. The approach channel provided satisfactory flow to the spillway for all anticipated flow conditions. A design for the approach training walls was developed. Spillway discharge characteristics were determined for the following conditions: free uncontrolled flow, submerged uncontrolled flow, free controlled flow, and submerged controlled flow. Pressures measured on the crest indicated no negative pressure for any anticipated flow conditions. Hydraulic performance of the stilling basin was improved by elevating the stilling basin apron 15 ft and providing two rows of 15-ft-high baffles and a 12-ft-high end sill. Tests indicated that the downstream portion of the stilling basin training wall could be lowered for a length of 63 ft without impairing hydraulic performance. The magnitude and frequency of the hydraulic forces acting on the stilling basin sidewalls were computed. The invert of the exit channel was elevated 5 ft for sediment transport and hydraulic purposes. The riprap design developed for the exit channel provided adequate protection for anticipated flow conditions, including 90,000 cfs passing through a single bay. (Author's abstract)
W88-11278

MUDDY CREEK GRADE CONTROL STRUCTURES, MUDDY CREEK, MISSISSIPPI AND TENNESSEE: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W88-11283

STEELE BAYOU GRAVITY CONTROL STRUCTURE, VICKSBURG, MISSISSIPPI: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. B. Fenwick.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report No. HL-88-12, June 1988. Final Report. 78 p, 5 fig, 2 tab, 11 photos, 24 plates.

Descriptors: *Hydraulic models, *Steele Bayou, *Hydraulic structures, *Scour, *Environmental effects, Erosion, Eddies, Channel erosion, Dikes.

A hydraulic model was used to evaluate various schemes to eliminate the severe turbulence and eddies that have caused drastic erosion problems downstream of the Steele Bayou drainage structure. Significant bottom scouring and bank sloughing have occurred during the outflows following spring floods. The study was conducted to develop a solution for the excessive sour in the channel reach between Mississippi Highway Bridge No. 465 and the Steele Bayou structure where a 40-ft-deep by 600-ft-wide scour hole developed in the prototype. The longitudinal dikes, recommended as a result of the model tests, were installed in 1985 and have performed well through a period of relatively high water. (Author's abstract)
W88-11284

8C. Hydraulic Machinery

EXPERIENCE IN THE CONSTRUCTION AND OPERATION OF STEEL PRESSURE PIPELINES OF HYDROPOWER DEVELOPMENTS,
For primary bibliographic entry see Field 8A.
W88-10218

SOME PROBLEMS OF THE MANUFACTURING TECHNOLOGY OF MECHANICAL EQUIPMENT AND STEELWORK OF HYDRAULIC STRUCTURES,
V. N. Sidnev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 134-139, September 1988. 1 fig. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 19-22, March 1987.

Descriptors: *Mechanical equipment, *Hydraulic structures, *Hydraulic machinery, *Hydraulic design, *Soviet Union, Technology, Economic aspects, Planning, Labor.

An improvement of manufacturing technology of structural members being designed is one of the important untapped reserves for increasing the productivity of labor when designing, tooling, manufacturing, installing, and maintaining mechanical equipment and special steelwork of hydraulic structures. Such technology will simultaneously decrease the expenditures of labor, means, materials, and time while providing the prescribed indices of article quality as adopted by the industry. This paper focuses on the following problems: (1) reduction of labor intensity and cost of manufacture and installation of articles, including designation of a rational layout of the structure and structural elements, and (2) the decrease of labor intensity, cycle, and cost of works during operations. The given example shows that a thorough analysis of all positive and negative factors, with their quantitative evaluation, is required for making an optimal decision. Such a decision requires considerable time from design specialists studying the variants and calculating and analyzing the technical and economic indices. This process increases the labor intensity of the design process, and the economic effect is felt at the production and operation stages. (Friedmann-PTT)
W88-10219

MANUAL INTERNAL VIBRATOR FOR COMPACTING WET CONCRETE,
G. L. Gershanovich.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 139-145, September 1987. 1 fig, 3 tab, 6 ref. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 23-27, March 1987.

Descriptors: *Concretes, *Compaction, *Technology, Pipelines, Machinery, Drainage systems, Concrete testing.

This paper examines three types of massive blocks in the technology of vibration compaction of wet concrete by internal vibrators. The first type is blocks that are completely amenable to compaction by machines. The second type is blocks with various elements inside them, limiting the work of machines and also forcing the use of manual compaction. Such elements include reinforcing bars, pipes of drainage systems, instruments and communication lines of the monitoring and measuring equipment, projections from the precast lining structures, standpipes of the cooling systems, formwork of the galleries and stairwells, technological pipelines, etc. The third type is blocks in which the indicated obstacles make operation of machines completely impossible. (Friedmann-PTT)
W88-10220

HYDRAULIC CHARACTERISTICS OF STRAIGHT CONICAL DIFFUSERS OF HYDROPOWER PLANTS,
V. Y. Karelin, N. V. Gromik, and V. V. Volshanik.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 151-158, September 1987 6 fig, 2 tab, 10 ref. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 31-35, March 1987.

Descriptors: *Diffusers, *Hydraulic design, *Hydraulic structures, *Hydaulic equipment, *Hydraulic machinery, *Hydroelectric plants, Hydraulic loss, Discharge rates.

This study investigated the hydraulic characteristics of straight conical diffusers at the Moscow and Brest Civil Engineering Institute (U.S.S.R.), under various conditions of discharge of axial and swirling flows. Study results showed that, in the case of discharge of a flow from a network ending with a diffuser onto a flat shield, the value of the hydraulic losses depends on the distance between the shield and outlet section of the diffuser. In the case of discharge onto a free shield, the optimal values of the distance from the diffuser outlet section to the shield (in fractions of the diffuser inlet diameter) are: 0.7-0.9 for a diffuser with angle 8 degrees and 0.4-0.6 for a diffuser with angle 16 degrees. A change in the values of the Reynolds number leads to a change in the flow regime in the diffuser whose outlet section is affected by the backwater caused by the shield, and leads to a change in the values of the resistance coefficient. Swirling of the flow in the outlet section of the diffuser leads to an insignificant decrease of the resistance coefficient of the diffuser affected by the shield backwater. The correct selection of the dimensions of the rectangular outlet chamber makes it possible to achieve a noticeable decrease of the values of the hydraulic resistance coefficient of the diffuser with a chamber outlet. (Friedmann-PTT)
W88-10222

DINERWIG PUMPED-STORAGE STATION,
M. F. Krasil'nikov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 173-182, September 1987. 4 fig, 4 tab. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 45-51, March 1987.

Descriptors: *Hydraulic structures, *Pumped storage, *Site selection, Pipelines, Quarries, Hydraulic engineering, Technology.

The Dinerwig pumped-storage station in North Wales, Great Britain, with a capacity of 1800 MW, is one of the world's largest pumped-storage stations and is located in the interior of Mt. Elidir under a slate quarry near the city of Dinerwig. For this paper, two variants of siting the pumped-storage station were examined - underground and above-ground. As a result of thorough studies, the designers rejected the above-ground variant, mainly owing to an increase of the length and diameter of the steel lining of the pressure tunnels related to this, and owing to the need to deepen the reversible units 60 m below the level of the lower pool. The first starts and initial experience in operating the Dinerwig pumped-storage station revealed certain troubles in the operation of the reversible units and the need to modernize its individual components and elements: (1) Due to unreliable operation, it was necessary to change the upper bearings of the vanes of the gate apparatus, the seal of the shaft of the pump-turbine and the drainage system pipes; (2) failures in the operation of the servomotors and seals of the before-turbine gates were observed; (3) strengthening of the fastening of the hold-down plates of the stator of the generator-motor was required; (4) disturbances were noted in the operation of the system when automatically starting and converting from one operating regime to another; (5) in the initial period, frequent disconnection of the excitation system occurred due to short-circuits in the thyristor converters. (Friedmann-PTT)
W88-10226

MEASUREMENT OF WATER DISCHARGE IN SHORT SECTIONS OF CONDUITS BY MEANS OF ORIFICES,
For primary bibliographic entry see Field 7B.
W88-10432

DETERMINATION OF THE LIFTING FORCE AND RATIONAL FORM OF VERTICAL LIFT-FALLING GATES,
V. V. Balanin, and V. A. Krivoshei.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 113-122, August 1987. 8 fig, 3 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 14-17, February 1987.

Descriptors: *Hydraulic design, *Design criteria, *Gates, *Locks, *Vertical lift-falling gates, *Hydraulic gates, *Hydraulic design, *Hydraulic models, Discharge coefficient, Mathematical models, Mathematical analysis, Prediction, Structural models.

Vertical lift-falling gates have found wide use on locks in the USSR. Since the lifting force necessary for operating the gates is determined by a large number of independent parameters, theoretical solutions are impractical, and experimental investigations on physical models in each case must be conducted. An investigation was performed and a method of calculations developed to make it possible to determine the lifting force of lift-falling gates with a flat inclined deflector for practically any combination of the main parameters determining this quantity. For determining the lifting force by the given method, there is no need for costly and labor intensive experimental investigation. The head on the sill, height of lifting the gates, and angle of inclination of the stream deflector to the vertical have the maximum effect on the lifting force. The most rational design of lift-falling gates is that with a deflector described at first by a circle with a radius of 1.5 m and then by a line inclined at an angle of 50 degrees to the vertical conjugate with it and with a seal transferred to the sill. Such a design with a small lifting force improves the hydraulics of the flow in the region of the gates and provides a high discharge coefficient. The latter makes is possible to reduce the gate operating cycle and to shorten the rod length of the hydraulic cylinder. (VerNooy-PTT)
W88-10434

COMBINED DIVERSION AND SERVICE TUNNEL SPILLWAY OF THE TASHKUMYR HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W88-10585

START-UP SYSTEM FOR PUMPING OPERATION OF THE REVERSIBLE UNITS AT THE DINERWIG PUMPED-STORAGE STATION,
M. F. Krasil'nikov, and A. M. Krasil'nikov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 301-304, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 53-55, May 1987. 2 fig, 1 tab, 1 ref.

Descriptors: *Hydraulic machinery, *Pumped storage, *Pumping plants, *Electrical equipment, *Civil engineering, Water resources development, Design criteria, Design standards, Dams, Construction, Quality control, Dinerwig pumped-storage station.

The main scheme of the electrical connections of the Dinerwig pumped-storage station is given. Each motor-generator is connected to a power transformer through switches for changing the alternation of phases, one of which is intended for operating the units in a pump regime and the other in a turbine regime. It is necessary to note that switching of the motor-generator from one operating regime to the other is accomplished by single-phase isolating switches with automatic control assembled into three-phase groups. The use of five-pole isolating switches was considered inexpedient for economic reasons and in connection with a decrease of operating reliability. The duty operator can select and carry out any regime on any unit with minimum control actions and during running can regulate the devices related to synchronization, load, voltage, excitation system, and characteristics of the speed governor. A special device (rpm relay), consisting of three inductive transducers installed at an angle of 120 deg around the shaft of the unit and a gear located on the shaft of the unit in the region of the brush device of the motor-generator is used for measuring the frequency of revolution. This rpm relay delivers to the speed governor a continuous triple signal and during increased frequencies of revolution, two of the three signals. The six-tooth gear is installed directly on the shaft of the unit, and the tiree transducers on brackets fastened on the housing of the brush device. The air gap between the transducers and gear is 1.25 mm. Each transistor (designed by the American Society of Engineers and Architects) includes an oscillator, in which oscillation is cut off at the instant the tooth of the gear passes the transducer. The oscillator is connected to a transistor switch, which when the oscillations are cut off has an output voltage equal to the supply voltage of the transducer, i.e., 24 V of direct current. The maximum current consumption of the transducer is 14 mA. (Alexander-PTT)
W88-10589

ENERGY HEAD IMPLICATIONS OF THE INSTALLATION OF CIRCULAR FLAP GATES ON DRAINAGE OUTFALLS,
Liverpool Univ. (England). Dept. of Civil Engineering.
R. Burrows, and J. Emmonds.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 131-142, 1988. 6 fig, 12 ref.

Descriptors: *Hydraulic gates, *Energy loss, *Head loss, *Outfalls, *Flap gates, *Hydrodynamics, Design criteria, Design standards, Gates, Construction, Drains.

A program of experimental study on simple circular single hinged flap gates is reported. Energy losses resulting from the flow constriction created are found to be largely dependent upon the flow-rate and the gate's self weight when subjected to a tailwater surcharge. Guidance on gate selection and head loss implications in the literature is sparse and design curves are therefore presented here to partially fill this gap. These show that the total energy loss at the outfall resulting from the use of heavy gates can be more than double the kinetic energy head of the pipe flow, representing the normal pipe 'exit' losses. (Author's abstract)
W88-10764

CUMBERLAND SMALL HYDRO SCHEME COMPLETED IN THE WEST INDIES,
Shawinigan Engineering Co. Ltd., Montreal (Quebec).
C. J. Hanson.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 7, p 10-13, July 1988. 2 fig.

Descriptors: *Hydroelectric plants, *Hydroelectric power, *West Indies, *Construction, Planning, Pipes, Economic aspects, Cumberland River, Saint Vincent, Water resources development, Developing countries.

With commissioning of the third powerhouse of the Cumberland River development in April 1988, 3.5 MW of hydropower capacity was added to the power system of the caribbean Island of St. Vincent, West Indies. A 7 km-long system of wood-stave and steel pipelines, winding through the rugged terrain of the Cumberland Valley, develops the 290 m head, and supplies five Francis turbines. This article describes the three-powerplant development, from the feasibility study through to completion, including inversion weirs and intakes, pipelines, powerplant equipment, operation and control, and financing and implementation. (Author's abstract)
W88-10862

RIABA MINI HYDRO SCHEME IN EQUATORIAL GUINEA,
Electricite de France, Paris.
J. D. Mechali.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 7, p 16-19, July 1988. 4 fig.

Descriptors: *Guinea, *Hydroelectric power, *Hydroelectric plants, *Construction, *Economic aspects, Peaking plants, Developing countries, Water resources developement, Geology, Engineering.

The 3.8 MW Riaba project on Bioko Island will supply 17 GWh/year to Malabo, the capital of Equatorial Guinea. The installation is of the diversion type, and includes a daily regulating reservoir to allow energy to be concentrated for peak demand. Work began on the scheme in June 1987. The project is being financed by the Caisse Centrale de Cooperation Economique (France) and the European Investment Bank. This article describes the development of the Riabo project, including historical review, geology of terrain, construction, costs, and difficulties encountered. (Author's abstract)
W88-10863

ARE PUMPS WORTHWHILE TURBINES,
Hanover Univ. (Germany, F.R.). Inst. of Turbomachinery.
A. Engeda, and M. Rautenberg.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 7, p 19-20, July 1988. 4 fig, 1 ref.

Descriptors: *Hydroelectric plants, *Germany, *Engineering, *Pump turbines, Turbines, Pumps, Fluid mechanics, Construction, Design criteria, Cost analysis, Cavitation, Performance evaluation.

Despite the extensive literature on the use of pumps as turbines, only very few well-established applications using this knowledge have been reported. The lack of feedback on problems and experiences has not provided an adequate incentive to study more thoroughly the performance limitations and capabilities, and operational properties. This paper reviews the geometric and fluid dynamic properties of pumps in the turbine mode. More studies are required for a better understanding of the turbine operation of pumps, so that some criteria can be established for identifying pumps that are best suited for turbine operation. The pump as turbine is usually recommended only because it is inexpensive. The absence of a reliable methodology to enable optimal turbine selection from existing pump data makes it essential for the customer to have full turbine-mode test data, including cavitation properties, and the runaway and zero-speed limiting boundaries. The application area of reversible pumps is strictly defined for applications of less than 500 kW, where initial cost is more important than efficiency and a wider operating range, and where flow is more or less constant. (Friedmann-PTT)
W88-10864

DESIGN ASPECTS OF THE CASTEL MONTECCHIO PLANT IN ITALY,
Studio Associato di Ingegnaria, Brescia (Italy).
N. Frosio.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 7, p 22-26, July 1988. 5 fig, 1 tab.

Descriptors: *Italy, *Hydroelectric plants, *Design criteria, *Economic aspects, Construction, Management planning, Operations, River Oglio, Water demand, Water resources development, Engineering.

Some unusual design features of the Castel Montecchio mini hydro plant in Italy, that began operation in April 1987, are described. Civil works constructed fifty years ago were incorporated in the scheme, and have helped to make it economically feasible, although some refurbishment work has been necessary. The management and operation of the development has been complicated by the need to deal with the various requirements of other users of the river water. Intake structures, supply canal, powerhouse, tailrace, and automated control system are described. Particular care was taken in restoring the environment surrounding the plant because it eventually will be included in the River Oglio Natural Park. (Friedmann-PTT)
W88-10865

STANDARDIZATION AND LAYOUT OF THE RIVER MURZ CASCADE SCHEME,
Krauss (Dr.) Consulting Engineers, Graz (Austria).
For primary bibliographic entry see Field 8A.
W88-10866

WATER POWER WITHOUT WATERFALLS,
Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Lucas Heights Research Labs.
B. E. Abulnaga.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 7, p 33, 48-53, July 1988. 7 fig, 1 tab, 7 ref.

Descriptors: *Water wheels, *Turbines, *Hydroelectric power, *Efficiency, *Mathematical equations, Comparison studies, Performance evaluation, Savonius rotor, Economic aspects, Betz Law, Streams, Wind.

Based on the work of Savonius and Betz's theory the possible design of submerged or semi-submerged water turbines to convert the kinetic energy of a stream of water in an irrigation canal or a river is analyzed. The advantages of designing modern water current turbines using the experience gained in the design of modern wind turbines and hydrofoils are considered. Computations show that, for water speeds of 1 to 3 m/s, a power output of 0.3 to 8 kW/sq m (respectively) at Betz limit, may be expected. Using floats or support frames, the turbines should not require important civil engineering work, labor or capital investment. Compared with wind turbines, for an equal power density and coefficient, the wind speed has to be 9.345 times larger than the water speed, but the water turbine would be more heavily loaded. (Friedmann-PTT)
W88-10867

EFFECT OF UNSTEADINESS ON REYNOLDS STRESSES OF ACCELERATED PIPE FLOWS,
For primary bibliographic entry see Field 8B.
W88-10873

EFFECT OF THE CROSS-SECTIONAL SHAPE OF A CANAL ON THE PARAMETERS OF STEEP TRAVELING SURGES,
A. V. Mishuev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 447-455, February 1988. 8 fig, 1 tab, 4 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 5-10, August 1987.

Descriptors: *Channel morphology, *Flood waves, *Unsteady flow, *Surges, *Cross-sections, *Canals, Slopes, Banks, Channel flow, Hydrodynamics, Fluid flow, Model studies, Mathematical studies, Physical properties, Flow velocity, Pumping, Hydraulic structures, Earthworks, Unsteady flow, Traveling waves, Mathematical equations.

Steep traveling surges in canals and rivers are formed upon a comparatively rapid change in the discharge of water at the starting or end site. An analytical solution is presented to the degree of effect of the cross-sectional shape of a canal or river on the surge parameters. On the basis of the such an examination, it is shown that the solution is applicable for waves of any intensity only for a canal with a rectangular section, and for weak waves for canals of any section. For canals with a triangular and trapezoidal section, the propagation and flow velocities in the bore, owing to the presence of a transverse component, are substantially lower than those calculated by one-dimensional equations and are lower, the more sloping the banks. The main theoretical positions were confirmed by experiment. (Friedmann-PTT)
W88-10880

APPLICATION OF MULTIPLE JET PUMPS FOR GROUND WATER RECOVERY,
Kindle, Stone and Associates, Inc., Longview, TX.
For primary bibliographic entry see Field 5G.
W88-11197

IMPLEMENTATION OF A HYDRAULIC BARRIER UTILIZING AN EXTRACTION AND INJECTION WELL SYSTEM,
EMCON Associates, San Jose, CA.
For primary bibliographic entry see Field 5G.
W88-11259

PHOTOVOLTAIC WATER PUMPING FOR BOLIVIA,
Sandia National Labs., Albuquerque, NM.
For primary bibliographic entry see Field 4B.
W88-11274

8D. Soil Mechanics

DIRECT DETERMINATION OF PERMEABILITY OF CLAY UNDER EMBANKMENT,
Laval Univ., Quebec. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W88-10193

APPLICATION OF A GEOMEMBRANE AT NIGERIA'S ISANLU DAM,
Babtie, Shaw and Morton, Glasgow (Scotland).
For primary bibliographic entry see Field 8A.
W88-10394

STRESSES AND CRACKS IN THE ROCK FOUNDATION OF AN EARTHFILL DAM,
Royal Inst. of Tech., Stockholm (Sweden).
E. Reinius.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 6, p 33-36, 38, June 1988. 13 fig, 2 tab, 3 ref.

Descriptors: *Stress, *Cracks, *Dam foundations, *Dams, *Rock fill, *Deformation, Hydraulic structures, Hydraulic engineering, Engineering, Grouting, Seepage, Embankment dams, Water pressure, Reservoirs, Dam stability, Dam failure, Physical properties, Mechanical failure, Mathematical analysis, Mathematical equations, Rheology, Tensile stress, Construction materials, Leakage, Boreholes, Cements, Foundation failure.

The deformations of an embankment dam are very great compared with the deformations of the rock formation. Therefore, the latter are usually neglected when calculating stresses and deformations of the dam body. However, experience has shown that small deformations of the rock foundation may result in open cracks across the grouted zone. The cracks may be so wide that fine-grained material from the core can be removed by seepage water. A study is made of stresses at the rock foundation and of the deformations and open cracks which may arise when the rock foundation is loaded, first, by the embankment dam and then by the water pressure from the reservoir. Methods to protect the contact zone (below the core) against open cracks and the base of the core against erosion are discussed. Measures to avoid the risk of this type of damage include: (1) stopping the formation of one or more cracks running across the grouted core zone at the rock surface by means of a concrete slab on the rock surface above the grouted screen; and (2) stopping the transport of fine materials from the core by means of a sand filter on the surface to cover a sufficient area downstream of the core. (Author's abstract)
W88-10395

COMPUTER MODELLING OF EMBANKMENT DAMS: RESPONSE TO EARTHQUAKE,
Motor-Columbus Ingenieurunternehmung A.G., Baden (Switzerland).
R. Dungar.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 6, p 39-40, 43-44, 46, June 1988. 6 fig, 12 ref.

Descriptors: *Computer models, *Dams, *Embankment dams, *Earthquakes, *Dam stability, *Model studies, Load distribution, Hydraulic loading, Hydraulic structures, Dam design, Computers, Drainage, Saturation, Stress, Rheology, Safety, Philippines, Conwap Dam, Design criteria.

Seismic effects often constitute a major design hazard for a large dam, and a realistic solution requires that the pre-earthquake static conditions be analyzed, as well as the earthquake loading conditions. Methods of analysis are considered for constructional, impounding, and seismic loads. Seismic results for the Conwap rockfill dam of the Casecnan trans-basin project, Philippines, are presented, and the difference in embankment response to two different earthquakes, with the same peak acceleration, is illustrated. It is concluded that these calculations are best achieved by using a full non-linear solution together with a material model that fully represents elasto-plastic material behavior. Partial saturation conditions should also be represented. The resulting model enables time-dependent as well as permanent displacement, stresses, and pore pressures to be calculated. The dynamic stability of the embankment is automatically controlled during the solution process, and the calculated permanent displacements enable the freeboard to be designed. The solution can also highlight any inadequacies in the original design, enabling the necessary changes to be made. (Author's abstract)
W88-10396

SOME PROBLEMS OF IMPROVING GEOTECHNICAL INVESTIGATIONS FOR HYDROTECHNICAL CONSTRUCTION,
S. V. Bortkevich.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 84-90, August 1987. 3 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 32-36, February 1987.

Descriptors: *Engineering geology, *Clays, *Soil mechanics, *Soil tests, *Field tests, *Construction materials, Soil properties, Foundation rocks, Design criteria, Geological surveys, Computer models, Dam construction, Hydroelectric plants, Soviet Union.

In an evaluation of the engineering-geological conditions of constructing hydrotechnical structures, an important role is played by quantitative criteria of the state and properties of the rocks of the engineering-geological elements of the investigated region and body of the earth structures. Two principal directions are distinguished in geotechnical investigations according to the character of the problems being solved; study of soils as the foundation of the structures, and as material for them. Problems in evaluating and testing soils, especially clays, are discussed, including field test apparatus and computer analogs. In studying soils as construction materials, sampling should be performed at all stages of surveying and include taking of initial samples from exploratory excavations and natural deposits and treating and bringing the initial samples to the mass necessary for the appropriate tests. For all of these tests, the geotechnical service is recognized to be the link to unite the efforts of surveyor and designers in the development of the optimum designs. For solving the main problems in the area of studying the properties of soils during surveys, it is necessary that the share of the geotechnical service in surveying corresponds to that share which problems of geotechnics occupy in the materials of engineering-geological substantiation of the design of hydrotechnical structures. (VerNooy-PTT)
W88-10429

PROBLEMS OF QUALITY CONTROL IN CONSTRUCTING EARTH DAMS,
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
A. G. Chernilov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 251-256, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 9-14, May 1987. 3 fig, 7 ref.

Descriptors: *Construction, *Earth dams, *Quality control, *Soil compaction, *Soil mechanics, *Civil engineering, Water resources development, Design criteria, Design standards, Electric powerplants, Hydroelectric power, Dams, Soil profiles.

Until recently practically no attention was devoted to problems of quality control in the construction of earth dams. The classical system of quality control of placing earth materials in dams is based on a comparison of the actually attained quality indices (dry density of the soil, particle-size distribution) and control values of these parameters regulated by the design and technical specifications on placing soils in the dam. Various standards make it the duty of geotechnical control to check possible segregation, thickness of the layers, and technology of placing and rolling in the soil. Current methods of conducting geotechnical control when constructing high earth dams do not have effective criteria for evaluating the technology and therefore they cannot provide real quality control of dam construction. A system of controlling the quality of constructing earth dams with the use of the technology safety factor analogous to the soil safety factor, realizing feedback of geotechnical control with the technology of preparing, placing, and compacting, soils is suggested. A check of the proposed quality control system when constructing earth dams showed its sufficient effectiveness and prospects of its further development and improvement. (Alexander-PTT)
W88-10579

WAYS TO REDUCE THE COST AND TIME OF CONSTRUCTING EARTH DAMS,
For primary bibliographic entry see Field 8A.
W88-10580

ENGINEERING THEORY OF SLIDE PROCESSES IN THE DESIGN OF EARTH DAMS ON A SOFT GROUND FOUNDATION,
N. A. Krasil'nikov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 263-268, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 18-22, May 1987. 2 fig, 3 tab, 11 ref.

Descriptors: *Dam failuare, *Landslides, *Construction, *Earth dams, *Model studies, *Soil mechanics, *Civil engineering, Water resources development, Design criteria, Design standards, Electric powerplants, Hydroelectric power, Dams, Quality control, Soil compaction, Soil profiles, Prediction.

The engineering theory of slide processes, existing practice (slides that have occurred on constructed earth dams), and also the existing standards and recommendations both show that for earth dams having a soft ground foundation, rotational slip along a cylindrical surface is potentially the most dangerous. Furthermore, the theory of slide processes and existing practice show that slides due to bulging and spreading are also possible on these dams. However, existing standards and recommendations orient the designer to checking the stability of slopes of weakened interlayers along plane surfaces of sliding. Investigations show that the engineering method of calculating the stability of slopes of earth dams must be combined with other operations providing prediction and monitoring of the stability of the slopes. It is also desirable to check the method of calculation on a number of dams that have actually failed; the VNIIG-Terzaghi method, for example, passed such a check. It is very important to check the initial geological information during construction by engineering means -- to construct an experimental embankment equipped with monitoring and measuring instruments, etc.-- and also to repeat the calculations of the dam after each refinement of the initial information in order to correct in good time the design of the dam in conformity with the actual conditions. (Alexander-PTT)
W88-10581

STRESS-STRAIN STATE, SEEPAGE STRENGTH, STABILITY, AND OPTIMIZATION OF EARTH DAMS,
L. N. Rasskozov, V. P. Nedriga, and A. L. Mozhevitinov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 273-278, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 25-28, May 1987. 4 fig, 1 ref.

Descriptors: *Stress, *Strain, *Stability, analysis, *Seepage, *Optimization, *Soil mechanics, *Earth dams, *Quality control, Soil compaction, Soil profiles, Civil engineering, Water resources development, Design criteria, Design standards, Electric powerplants, Hydroelectric power, Dams.

The start of the investigation of the stress-strain state (SSS) of earth dams can be dated to the end of the 1950s and start of the 1960s. There is an extensive set of computational programs for determining the SSS of an earth dam based on various soil models. On the basis of these models it is possible to obtain the SSS of the dam with consideration of the staged construction in two-dimensional and three-dimensional formulations. Problems of investigating the consolidation of soils of the body and foundation of a dam, seepage, including consideration of the nonlinearity of the physical equation, and stress-strain state of dams in two- and three-dimensional formulations have been practically removed from the agenda. Problems of the reliability of converting from SSS to stability and optimization of the design of hydraulic structures with consideration of industrial methods of construction are being solved. The introduction of probabilistic methods of evaluating the SSS and stability of dams and combination of probabilistic methods with methods of optimization of designs serves to accelerate construction. (Alexander-PTT)
W88-10583

METHODS OF DETERMINING THE PARTICLE-SIZE DISTRIBUTION OF COARSE SOILS USED IN CONSTRUCTION,
O. A. Pakhomov, and V. I. Kopatilov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 278-281, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 29-31, May 1987. 1 tab, 6 ref.

Descriptors: *Construction, *Particle size, *Soil mechanics, *Soil properties, *Analytical methods, Measuring instruments, Civil engineering, Soil compaction, Statistical methods, Model studies, Physical properties, Design criteria, Design standards, Field tests, Economic aspects, Safety.

In construction practice the need can arise for determining the size distribution of various coarse material, including lumps of cohesive soil with a low moisture content obtained when excavating soft ground by large-bucket excavators. Among the indirect methods the following statistical methods in recent years have been used more often than others; photogrammetric, point, and linear. The photogrammetric method reduces to photographing the surface of the plot with soil and office analysis of the photographs of the same scale made from several sides. In contrast to this, the point and linear methods call for determination of the size distribution not under office but under on-site conditions. The sequence of operations in these methods hardly differs and reduces to the following: two persons participate, the operator and laboratory assistant; they mark and fix the site for measurements; go around to all sites sequentially and take measurements; and process the results obtained. The point method calls for fraction-by-fraction recording of the number of 'particles' at points located every 0.5-1 m along selected lines and the size distribution is calculated as the ratio of the number of points of each of the recorded fractions to the sum of the points of all recorded fractions. The linear method involves not recording by rather a fraction-by-fraction measurement of the length of projection of a cord onto each 'particle' encountered when moving along the lines and the size distribution is calculated as the ratio of the length of the projection of the cord of each of the measured fractions to the sum of the projections of all measured fractions. Both these methods can be considered competitive in simplicity and speed of execution, labor intensiveness, and accuracy of the results. Preference is given to the linear method because it is accompanied by direct quantitative measurements and not by recording the number of 'particles' of a particular fraction. (Alexander-PTT)
W88-10584

MONITORING OF THE SEEPAGE REGIME OF EARTH STRUCTURES,
For primary bibliographic entry see Field 8G.
W88-10588

SIMULATED MOTION OF A LOOSE REVETMENT BLOCK,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. M. Townson.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 225-242, 1988. 12 fig, 10 ref, append.

Descriptors: *Bank protection, *Structural behavior, *Revetment blocks, Mathematical studies, Model studies, Simulation analysis.

The equations of motion are developed for an unrestrained revetment block lying on a free-flowing filter layer, subject to harmonic base pressure during wave downrush. The resulting trajectories are calculated numerically and depicted at discrete time intervals. The influence is then estimated of progressive decreases both in the spacing of adjacent blocks and in the filter layer permeability. Some consideration is also given to small-amplitude, continuous oscillations. It is suggested that reductions in filter thickness and permeability are more effective in reducing block uplift than are increases in block thickness. (Author's abstract)
W88-10766

OUTLINE OF AN EARTH SLOPE IN THE WATERLINE PART OF LARGE CANALS AND RESERVOIRS,
A. D. Girgidov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 488-493, February 1988. 4 fig, 6 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 35-38, August 1987.

Descriptors: *Cross-sections, *Embankments, *Reservoirs, *Canals, *Slope stability, Channel flow, Hydraulic structures, Water level, Shear stress, Mathematical studies, Physical properties, Earthworks.

The cross-sectional outline of large unlined earth canals in the waterline zone can be determined by means of the scheme described here, which uses the interaction of the channel flow with the soil constituting the banks. It is asserted that a freely-standing vertical bank forms on the canal bank as a result of the removal of soil particles by water during wave motion into the channel flow. To solve the problem of the most dangerous surface of failure, for which a minimum value of the factor of safety against sliding from the entire earth structure as a whole occurs, it is necessary to be able to solve two problems: (1) to be able to determine normal and shear stresses on any arbitrary surface constructed in the space occupied by soil and (2) to select from all possible surfaces that on which the factor of safety (k) has a minimum value. Calculation of slope stability on the basis of the variational method has a sufficiently general character; approximation of the failure surfaces, shown as cylindrical surfaces, is rough, and consequently the factors of safety against sliding according to the cylindrical surface method will have overestimated values. (Friedmann-PTT)
W88-10875

HYDRAULIC RESISTANCES OF LARGE UNLINED CANALS IN NONCOHESIVE SOILS,
For primary bibliographic entry see Field 8B.
W88-10885

8E. Rock Mechanics and Geology

FOUNDATION DESIGN OF ANCHORED WALLS, BAY SPRINGS LOCK, MISSISSIPPI,
Army Engineer District, Nashville, TN.
For primary bibliographic entry see Field 8A.
W88-10167

ESTIMATED PERFORMANCE OF TWITCHELL ISLAND LEVEE SYSTEM, SACRAMENTO-SAN JOAQUIN DELTA, UNDER MAXIMUM CREDIBLE EARTHQUAKE CONDITIONS,
California State Dept. of Water Resources, Los Angeles. Southern District.
For primary bibliographic entry see Field 8A.
W88-10168

GEOELECTRICAL PROPERTIES OF SELECTED ROCK AND WATER SAMPLES FROM SAN SALVADOR ISLAND, BAHAMAS,
Akron Univ., OH. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W88-10169

ECOLOGY OF SOME WATERS IN THE FOREST-AGRICULTURAL BASIN OF RIVER BRYNICA NEAR THE UPPER SILESIAN INDUSTRIAL REGION: 11. ICHTHYOFAUNA OF THE RESERVOIR AT KOZLOWA GORA AND LAKE CHECHLO-NAKLO,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W88-10187

CORRELATION OF PIPELINE DAMAGE WITH GROUND MOTIONS,
Weidlinger Associates, Palo Alto, CA.
M. E. Barenberg.
Journal of Geotechnical Engineering JGEND2, Vol. 114, No. 6, p 706-711, June 1988. 2 fig, 9 ref.

Descriptors: *Pipelines, *Earthquakes, *Seismic waves, *Damage, *Ground motion, Networks, Water conveyance, Maintenance, Ground displacement, Seismic design.

It is generally recognized that in order to minimize damage after a major disaster such as an earthquake, underground water-distribution pipeline networks must be able to perform with as little disruption in service as possible shortly after the event. An important step in analyzing the response of underground pipelines to ground motions is determining how much damage would be expected for a given level of ground motion. While additional data are required to apply with confidence the results of this study to other conditions, the results show that it is reasonable to characterize pipeline damage with a transient ground motion parameter in a region of low-intensity shaking and permanent ground displacement in regions of high-intensity shaking. The best documented case for the correlation of pipeline damage with permanent ground displacement is in the region dominated by the surface expression of the fault of the San Fernando earthquake. The data for the displacement and pipeline damage calculations were obtained from the National Oceanic and Atmospheric Administration. The data analyzed in this study covered only a limited range of geologic conditions and pipe classifications but as more data becomes available future analysis may allow the curves to be defined for different diameters and types of pipe. (VerNooy-PTT)
W88-10194

CONSTRUCTION OF GEODETIC NETWORKS FOR STUDYING CRUSTAL MOVEMENTS WHEN CREATING HYDRAULIC STRUCTURES IN SEISMIC REGIONS,
P. A. Ostropiko, A. P. Kartashov, and P. A. Atrushkevich.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 145-150, September 1987. 2 fig, 9 ref. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 27-30, March 1987.

Descriptors: *Dams, *Reservoirs, *Network design, *Seimic data, *Tectonics, *Hydraulic structures, *Hydraulic design, Seismic properties, Construction, Hydraulic engineering, Geologic formations, Networks.

Among the engineering problems being solve at the stage of design and construction of large projects in seismic regions of the Soviet Union, the problem of a space-time study of contemporary crust movements (CCM) is important. The study investigated the regularities of CCM in the region of a hydraulic structure at the stage of design and construction to determine its safe future operation. Data on CCM obtained during construction and initial stage of operation at a hydraulic structure permitted prediction of the degree of the technogenic effect on the geokinematic conditions of the region and determination of the relation between the dynamics of filling a reservoir and the character of local seismicity. Some methodological aspects of constructing networks for studying contemporary vertical crustal movements (CVCM) are presented, using examples of the geodetic works in the regions of the design an construction of the Bartogai reservoir on the Chilik river, and the Bestyuba reservoir on the Charyn River in highly seismic regions of the Northern Tien Shan. On the basis of the particular examples of geodetic works presented, the authors recommend the following sequence of studying CVCM in highly seismic regions of constructing large hydraulic structures: (1) a study of the geological structure of the region from literature sources (morphostructural plan, fault tectonics, contemporary crustal movements); (2) study of the contemporary crustal movements from the results of precision levelings of the state vertical control network. Study of the degree of activity of large faults in the crust of the region in connection with strong earthquakes; (3) creation of networks of the first level -- deformation areas -- in the region of the site of the dam and other large structures, regime observations for studying the small-block structure of the construction region (microregionalization) and activity of microfractures and cracks; (4) equipping the networks of the second level and establishment of the initial stage of observations on long profiles around the bed of the future reservoir and across the shores. (Friedmann-PTT)
W88-10221

ON-SITE INVESTIGATIONS OF THE EFFECT OF EXTERNAL FORCES ON THE CONTACT ZONE OF THE BRATSK DAM,
For primary bibliographic entry see Field 8A.
W88-10223

URGENT PROBLEMS OF GEOLOGICAL SUBSTANTIATION OF GEOMECHANICAL CALCULATIONS,
A. A. Varga.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 59-64. August 1987. 2 fig, 10 ref. Translated from Gidroekhnicheskoe Stroitel'stvo, No. 2, p 14-17, February 1987.

Descriptors: *Engineering geology, *Data interpretation, *Structural geology, *Geophysics, *Rock mechanics, *Rock properties, Classification, Structural models, Errors, Computer models, Stress analysis, Rock testing, Geological surveys.

This examination of current problems of geomechanical interpretation of geological data shows their exceptional complexity and poor development. The parameters for classification of rock masses are discussed. Problems of engineering-geological modeling and microregionalization of rock masses are detailed, as well as the problem of scale effect. Other areas of concern are estimating the internal stress state of a rock mass and perfecting the method of analogs via computer modeling. In interpreting geological data, the magnitude of inaccuracy of the geomechanical parameters and calculations usually remains vague. An immediate elaboration of these methodological problems is necessary, which substantially depends on an understanding of the structure of the mass as well as on the process of formation of its geomechanical properties, and should be carried out primarily at the level of a geological study of the rock foundation with the maximum use of engineering geophysics and in close contact with rock mechanics. (VerNooy-PTT)
W88-10425

CURRENT STATE AND WAYS TO DEVELOP ENGINEERING GEOPHYSICS,
A. I. Savich.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 64-71, August 1987. 5 fig, 12 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 18-23, February 1987.

Descriptors: *Hydroelectric plants, *Institutions, *Geophysics, *Seismology, *Engineering geology, Foreign projects, Geological surveys, Geologic mapping, Computers, On-site investigations, Monitoring, Well logs, Institutions, Dam construction, Soviet Union.

In recent years there has been an increase in the volume of geophysical works performed by the All-Union Planning, Surveying, and Scientific-Research Institute (Gidroproekt) during surveys and construction of large power installations. However, with such a volume of works, the increased requests for conducting geophysical investigations are presently not being satisfied. For a number of years, problems have arisen due to the discrepancy between the complexity of the problems being solved to the technical equipment and existing organizational structure of the geophysical surface. In recent years, in connection with the rapid development of electronics and computers, geophysical exploration and well-logging equipment has radically changed. Despite these achievements, the geophysical service of Gidroproekt with respect to equipment remains at the level of the 1960's. Another problem discussed is the need for the creation of regional geophysical bases in various regions of the country for increasing geophysical services, and a unified interpretation center for processing data. A discussion of the institute's main recent achievements are also discussed. These include investigations related to a study of the natural engineering-geological and seismic conditions of the sites of power installations; investigations in the course of construction during which the changes in the properties and state of the investigated masses under the effect of technogenic factors are evaluated; and long-term or regime (on-site) geophysical and seismological observations performed to check the behavior of the foundations of the structures during their operation. (VerNooy-PTT)
W88-10426

USE OF THE ROCK PRESERVATION SCALE IN GEOMECHANICAL INVESTIGATIONS AND CONSTRUCTION,
L. S. Miroshnikova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 72-78, August 1987. 2 fig, 2 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 23-28, February 1987.

Descriptors: *Engineering geology, *Rock properties, *Classification, *Geophysics, *Design criteria, *Geological surveys, *Foundation rocks, Construction, Rock testing, Soil classification, Soviet Union, Hydroelectric plants, Prediction.

The rock preservation groups in the classification of masses serve as an an integral index of the properties of the mass. They enable geologists of the control engineering-geological documentation (CEGD) service documenting construction excavations (pits and underground workings) to predict in the shortest possible time the construction properties of the foundation soils and estimate its reliability as well as to make prompt decisions about engineering measures in the event it is necessary to equalize the inhomogeneity of the foundation (remove rock, strip large joints, grouting, etc.). Practice has shown that rock preservation groups as predictive parameters of construction properties are equally acceptable both for geologists and designers and for builders. Therefore is is expedient to include the classification of rocks according to preservation groups in the foundation specifications of various types of hydraulic structures. In the overwhelming majority of rock masses approximately five main groups of rocks can be distinguished, with division into subgroups with simultaneous consideration of the effect on the value of the modulus of deformation and shear characteristics, both of the compressive strength of the rocks in the specimen and degree of their

jointing (block structure) in their mass. These groups are defined in the paper. (VerNooy-PTT)
W88-10427

ENGINEERING-GEOLOGICAL SUBSTANTIATION OF THE DESIGNS OF UNDERGROUND HYDRAULIC STRUCTURES,
A. V. Kolichko, and V. K. Razumov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 79-84, August 1987. 3 fig, 12 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 29-32, February 1987.

Descriptors: *Engineering geology, *Underground structures, *Structural geology, *Alpine regions, *Hydraulic structures, *Rock mechanics, Hydraulic design, Hydroelectric plants, Stress, Compressive strength, Central Asia, Caucasus, Tunnel construction, Rock properties, Tectonics, Geophysics, Geological surveys, Soviet Union.

An examination is made of certain problems of the engineering-geological substantiation of the designs of underground structures characteristic for the mountainous regions of Central Asia and the Caucasus, i.e., Alpine orogenic regions with active tectonic processes, on the basis of the experience of designing and construction the Arpa-Sevan tunnel and tunnels of the Zhinvali, Rogun, Tashkumyr, and other hydroelectric stations. The characteristics of the underground hydraulic structures are substantiated by the contemporary tectonic, physical and geological processes occurring in the area. Engineering-geological information about rock mass should be expressed in the form of models, which should be corrected as construction reveals more information. The problem of evaluation of the stability of the working, and substantiation of the parameters of their support, must be solved with consideration of the natural stress state of the mass. It was also shown on the basis of considerable factual material that the thickness of the zone of decompression of rocks around a working as a function of its transverse dimensions has essentially a curvilinear character and depends on the parameters f sub ca (the inverse calculation of the strength coefficient) and n (the ratio of the maximum compressive stress existing in the mass to the uniaxial compressive strength of the rock in a specimen). (VerNooy-PTT)
W88-10428

HORIZONTAL DISPLACEMENTS OF ROCK FOUNDATIONS OF DAMS,
A. A. Karlson.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 2, p 100-104, August 1987. 1 fig, 3 tab, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 14-17, February 1987.

Descriptors: *Foundation failure, *Dam foundations, *Dam failure, *Dam stability, *Horizontal displacement, Rock mechanics, Foundation rocks, Arch dams, Bank erosion, Soviet Union, Reservoirs.

During on-site observations by geodetic methods at hydro developments, considerable attention is devoted to a study of horizontal displacement of rock foundations. Displacements exceeding those calculated, in a number of cases were the cause of failures or emergency situations as, for example, on the Malpasset arch dam (displacement of the lower part of the dam along the channel by 17 mm several months before failure) and Zeuzer arch dam (convergence of the banks at the site after long operation by 35 mm within several months, which led to a large deflection of the dam toward the upper pool and to the appearance of concealed cracks in it). The results of observations at a number of dams lead to several conclusions. Horizontal displacements of rock foundations toward the lower pool are small and even for high (100 m and more) dams in narrow and wider sites do not exceed 15-20 mm. The displacements rapidly die away with depth and at 10-15 m from the contact decrease by almost an order, and lowering the displacements of rocks toward the upper pool as a consequence of deflection of the reservoir can predominate. Filling of the reservoir led to the divergence or convergence of the banks. In the majority of cases convergence was observed, including in the case of gently sloping banks. The movements affected points located more than 100 m into the banks. (VerNooy-PTT)
W88-10431

IMPORTANCE OF STRESS RELIEF FRACTURING IN PREDICTING GROUND WATER MOVEMENT AND UNDERGROUND MINING EFFECTS,
Brown Engineering, Washington, IL.
For primary bibliographic entry see Field 2F.
W88-11101

GROUNDWATER POLLUTION POTENTIAL OF AIR FORCE INSTALLATIONS ON GLACIAL, ALLUVIAL, AND BASALT DEPOSITS OF THE NORTHWEST -- WASHINGTON, OREGON, AND IDAHO,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 5B.
W88-11147

8F. Concrete

MANUAL INTERNAL VIBRATOR FOR COMPACTING WET CONCRETE,
For primary bibliographic entry see Field 8C.
W88-10220

LONG-TERM SERVICE CHECKING OF THE CONCRETE OF THE CHIRKEY DAM,
Z. L. Zelenevskii, V. V. Draginich, and G. O. Draginich.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 164-167, September 1987. 3 fig, 5 ref. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 39-41, March 1987.

Descriptors: *Inspection, *Quality control, *Concretes, *Dams, *Monitoring, *Hydraulic structures, On-site investigations, Safety.

This paper describes experience in operation of the Chirkey concrete double-curvature arch dam (Soviet Union). With a height of 232.5 m, the dam is equipped with a considerable number of embedded monitoring and measuring instruments having various purposes. The new instruments introduced on the concrete arch dam of the Chirkey hydrostation can be recommended for wide use in nondestructive methods of service checking of the state of the concrete of hydraulic structures when evaluating their reliability and safety. The adopted method of nondestructive testing of the physical and mechanical characteristics of concrete with time objectively reveals their change; it is recommended for on-site investigations of the condition of concrete of all sections of the Chirkey dam. (Friedmann-PTT)
W88-10224

USE OF THE ACOUSTIC METHOD FOR CHECKING THE QUALITY OF CONCRETE OF HYDROELECTRIC AND PUMPED STORAGE STATIONS,
For primary bibliographic entry see Field 8G.
W88-10225

DAM ACTIVITIES IN THE USA,
United States Committee on Large Dams, San Francisco, CA.
For primary bibliographic entry see Field 8A.
W88-10393

DRIVING RAIN - CALCULATIONS AND MEASUREMENTS FOR BUILDINGS,
Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 2B.
W88-10567

LEAN ROLLCRETE FOR DAMS,
A. D. Osipov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 8, p 499-503, February 1988. 2 tab, 1 ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 45-48, August 1987.

Descriptors: *Concrete mixes, *Rolled concrete, *Concrete dams, *Cements, *Hydraulic structures, Fly ash, Freezing, Temperature effects, Gravity dams, Construction materials.

In the 1960s, the USSR found that a reduction in the cost of constructing concrete dams should be sought by creating concretes with the lowest possible heat liberation and, consequently, concretes with a minimum content of cement. In the absence of fly ash, natural pozollanas can be used, but it is necessary to grind them. It is also possible to use Portland blast-furnace cement as a mixed binder, provided that the blast-furnace granulated slags being used are acid. As noted earlier, the content of pure clinker Portland cement should not exceed 100 kg/cu m of concrete. The same materials are used as aggregates for lean concrete as for ordinary concrete. If it is necessary to use nonstandard materials for lean concrete with low strength indices, the requirements imposed on contamination of clay and strength of the coarse aggregate can be relaxed. But these problems should be solved in accordance with the particulate conditions. Many investigations have been conducted with respect to the heat liberation of cement in concrete. Since the content of cement does not exceed 100 kg/cu m, the increase of temperature in the concrete does not exceed 8-12 C under adiabatic conditions (without head losses). American specialists protect very lean mixes by richer ones. At the same time, lean rollcrete can be subjected to the effect of wheels and caterpillar tracks (without sheepfoots) of construction mechanisms immediately after compaction. Experiments on freezing of such a concrete conducted in the laboratory and in an outdoor stretch of a construction site of a Soviet hydrostation, showed that concrete subjected to freezing immediately after compaction does not lose the ability to harden during subsequent positive temperatures. Advantages of gravity dams made of lean rollcrete are listed. (Friedmann-PTT)
W88-10878

8G. Materials

ANTI-FOULING SURFACE MODIFICATION FOR LONGER-LIVED MEMBRANES WITH CONSTANT FLUXES AND SELECTIVITIES: AFT II,
Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 3A.
W88-10101

USE OF THE ACOUSTIC METHOD FOR CHECKING THE QUALITY OF CONCRETE OF HYDROELECTRIC AND PUMPED STORAGE STATIONS,
A. M. Filonidov, and V. Y. Lyubinskii.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 3, p 168-172, September 1987. 3 fig, 2 tab, 4 ref. Translated from Gidrotekhnicheskow Stroitel'stvo, No. 3, p 42-44, March 1987.

Descriptors: *Acoustics, *Inspection, *Quality control, *Pumped storage, *Concrete testing, *Hydroelectric plants, *Hydraulic structures, Precision, Pipelines.

One of the directions of improving the diagnosis of quality in concrete is the development and introduction of the acoustic method of testing, using an instrument that employs an elastic sound pulse. This makes it possible to test structures with a thickness of only up to 2 m by the series-produced ultrasonic instruments. For this paper, experimental investigations were carried out to test the accuracy and reliability of this concrete quality check by the acoustic method. The study investigated compressive strength with use of the 'velocity-strength' calibration relations on a massive concrete block (test stand of the research department of Gidroproekt), on 18 massive blocks of the Bratsk, Toktogu, and Kurpasai dams (U.S.S.R.), and on 130 blocks of wall beams, transverse beams

and five links of the pipeline of the Zagorsk pumped-storage station. The accuracy and reliability of determining the compressive strength of concrete by the described method was checked with the use of the data from the acoustic tests of the structural elements (blocks) and cores. It was established that the difference in the results of determining the compressive strength of concrete by the acoustic method versus core tests on a press does not exceed +/- 10%. The investigations established that by means of the non-destructive acoustic method, it is possible to determine and check the physical and mechanical characteristics of concrete in hydraulic structures of hydroelectric and pumped-storage stations under construction and in service with an accuracy sufficient for practical purposes, +/- 2-10%. (Friedmann-PTT)
W88-10225

APPLICATION OF A GEOMEMBRANE AT NIGERIA'S ISANLU DAM,
Babtie, Shaw and Morton, Glasgow (Scotland).
For primary bibliographic entry see Field 8A.
W88-10394

INCREASE OF THE EFFECTIVENESS OF SAFETY CONTROL OF HYDRAULIC STRUCTURES UNDER PRESSURE,
For primary bibliographic entry see Field 8A.
W88-10582

MONITORING OF THE SEEPAGE REGIME OF EARTH STRUCTURES,
A. P. Proshina.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 5, p 297-300, May 1987. Translated from Gidrotekhnicheskoe Stroitel'stvo, Vol. 21, No. 5, p 42-44, May 1987. 7 fig, 5 ref.

Descriptors: *Measuring instruments, *Seepage, *Piezometers, *Construction, *Soil mechanics, *Earth dams, Quality control, Soil compaction, Soil profiles, Civil engineering, Water resources development, Design criteria, Design standards, Electric powerplants, Hydroelectric power, Dams, Dneprodzerzhink hydroelectric station.

The earth dams of the Dneprodzerzhinsk hydroelectric station include: a right-bank dam, 2.2 km; channel dam, 1.4 km; left-bank dam, 3.3 km. The dams are hydraulic-fill from fine and medium sands and have a uniform profile with a permeability coefficient of 15-20 m/day. The height of the dam is 16-22 m, the steepness of the slope is 1:4. Immediately after hydraulic filling, monitoring and measuring equipment was installed on the dams and monitoring of the seepage regime was organized. Measurements of the water levels in piezometers were taken once a week until complete filling of the reservoir and stabilization of the seepage heads. Thereafter the measurements were taken once a month. An increase of the peizometric heads to 3.5 m and an increase of bypass seepage were noted on the right-bank abutment from the time of filling the reservoir between 1965 and 1983. In the lower pool discharge of groundwaters from the bank onto the surface occurred 80 m from the drainage ditch. In 1984 investigations of the seepage regime of the earth dams were carried out by the method of temperature measurements. The measurements were taken over the height of the water column in the piezometers monthly for a year. The flow rates of water in the dam are not the same either over the entire length of the dam or at each site separately. The seepage flow rate in the dam approximately corresponds to the design. The flow rate in the foundation of the dam is 2-3 times greater than in the body. The investigations confirmed the presence of sections of the dam with an increased permeability in the downstream shoulder. Almost all piezometers installed during construction have been preserved and are operating completely satisfactorily. (Alexander-PTT)
W88-10588

CONTAMINANT-RESISTANT SLURRY TRENCH,
McBride-Ratcliff and Associates, Houston, TX.
For primary bibliographic entry see Field 5G.
W88-11196

UNDERGROUND FUEL STORAGE SECONDARY CONTAINMENT: THE SOUTH FLORIDA EXPERIENCE,
Seaman Corp., Millersburg, OH.
For primary bibliographic entry see Field 5G.
W88-11208

8I. Fisheries Engineering

UTILITY OF THE MORPHOEDAPHIC INDEX IN THE PREDICTION OF FISH YIELD IN FINNISH LAKES,
Turku Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-10121

POTENTIAL IMPACT OF LARGE-SCALE TIDAL POWER DEVELOPMENTS IN THE UPPER BAY OF FUNDY ON FISHERIES RESOURCES OF THE NORTHWEST ATLANTIC,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 6G.
W88-10283

SUMMER ICHTHYOPLANKTON COMMUNITIES OF TWO ESTUARINE SYSTEMS OF PRINCE EDWARD ISLAND,
Prince Edward Island Univ., Charlottetown. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W88-10412

AGE CLASS DISTRIBUTION AND SIZE OF AMERICAN EEL (ANGUILLA ROSTRATA) IN THE SHETUCKET/THAMES RIVER, CONNECTICUT,
Connecticut Univ., Storrs.
J. R. Levesque, and W. R. Whitworth.
Journal of Freshwater Ecology JFREDW, Vol. 4, No. 1, p 17-22, June 1987. 1 fig, 5 tab, 15 ref.

Descriptors: *Age class, *Fish populations, *Eel, *Stream Biota, *Dam effects, Spatial distribution, Otoliths, Downstream, Upstream, Mature growth stage, Connecticut.

Age distribution of American eel (Anguilla rostrata) populations was compared at sites downstream from each of the first four dams inland from the mouth of the Shetucket/Thames River, CT., and at one site upstream of the fourth dam, during August, 1977. Ages were determined by interpretation of otoliths. The significant differences between age distribution of populations below (1 and 2) and above (3-5) the second dam revealed that dams did impede upstream movement of American eels in the Shetucket/Thames River. Additionally, length-weight relationships reported in other areas of the northeast, and in the entire Thames River Basin, were not significantly different from the pooled sample of American eel in the Shetucket/Thames River. (Author's abstract)
W88-10450

IMPACT OF TILAPIA GRAZING ON PLANKTON COMPOSITION IN ARTIFICIAL PONDS IN GUANACASTE, PROVINCE, COSTA RICA,
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W88-10455

OBSERVATIONS ON THE MIGRATION BEHAVIOR OF ALEWIFE (ALOSA ALOSA L.) IN THE ARTIFICIAL CANAL OF GOLFECH HYDROELECTRIC PLANT (OBSERVATIONS SUR LE COMPORTEMENT MIGRATOIRE DES ALOSES (ALOSA ALOSA L.) DANS LE CANAL ARTIFICIEL DE L'USINE DE GOLFECH),
Ecole Nationale Superieure Agronomique de Toulouse (France). Lab. d'Ichthyologie Appliquee.
For primary bibliographic entry see Field 6G.
W88-10467

COMPARISON OF DIGESTION METHODS FOR TRACE METAL DETERMINATION IN FISH.
Ibadan Univ. (Nigeria). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-10526

FISH COMMUNITIES IN THE PERENNIAL WETLAND OF THE SUDD, SOUTHERN SUDAN,
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 2H.
W88-10716

MANAGEMENT OF ARTIFICIAL REEFS DESIGNED TO SUPPORT NATURAL COMMUNITIES,
Lockheed-Georgia Co., Marietta.
For primary bibliographic entry see Field 5G.
W88-10748

RELATION OF THE ZOOPLANKTON BIOMASS AND SHARE OF LARGE CLADOCERANS TO THE CONCENTRATION OF TOTAL PHOSPHORUS, CHOROPHYLL-A AND TRANSPARENCY IN HUBNEOV AND VRCHLICE RESERVOIRS,
Ceskoslovenska Akademie Ved, Prague.
For primary bibliographic entry see Field 5C.
W88-10818

MEASURING FISH LENGTHS FROM INSTANT PHOTOGRAPHS USING A DIGITIZING TABLET AND MINICOMPUTER,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
For primary bibliographic entry see Field 7B.
W88-11016

SOUTHEASTERN ALASKA HATCHERY INNOVATIVE GROUND WATER SYSTEM,
Sweet, Edwards and Associates, Inc., Kelso, WA.
For primary bibliographic entry see Field 2F.
W88-11130

1986 ANNUAL REPORT FROM THE WATER BUDGET MANAGERS,
Fish Passage Center, Portland, OR.
For primary bibliographic entry see Field 6D.
W88-11272

CAMAS CREEK (MEYERS COVE) ANADROMOUS SPECIES HABITAT IMPROVEMENT PLAN,
Salmon National Forest, ID.
B. May, and R. W. Rose.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-009901. Price codes: A03 in paper copy, A01 in microfiche. DOE Report No. DOE/BP/64321--1, (1986). 31 p, 8 fig, 7 tab, 10 ref. DOE Contract DE-AI79-86BP64321. Project No. 84-23.

Descriptors: *Camas Creek, *Anadromous fish, *Habitats, *Environmental quality, Riparian land, Riparian vegetation, Environmental protection, Salmon, Trout, Columbia River Basin, Idaho, Costs, Channel improvement, Bank stabilization.

Potential enhancement and management options are analyzed that are designed to improve instream and riparian zone conditions in the Meyers Cove area of Camas Creek, Idaho. The efforts expended will contribute to improvement of anadromous species spawning, incubation and rearing habitat. Potential production increases would provide some compensation for hydropower effects in other areas of the Columbia River basin. The overall project has been divided into two separate but interrelated phases. This first phase was designed

to provide an assessment of enhancement options, potential schedules, and costs associated with the enhancement options. The second phase will involve implementation of actual enhancement measures and associated monitoring to verify fish response. The combined phases are intended to meet the stated project goal: To improve riparian and instream conditions of Camas Creek in the Meyers Cove area to increase spring chinook and steelhead trout spawning and rearing production potential. Enhancement of instream and riparian zone conditions within Meyers Cove area of Camas Creek will center on options and activities needed to increase riparian vegetation, increase streambank and channel stability, reduce recruitment of fine sediments, and to effect beneficial changes in instream rearing habitat. The three enhancement areas include: (1) Multiple use resource coordination; (2) Riparian/streamside zone enhancement; and (3) Instream enhancement. (Lantz-PTT)
W88-11275

ANALYSIS OF ALTERNATIVE FISH TRANSPORTATION STRATEGIES,
R. J. Harper.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-009912. Price codes: A04 in paper copy, A01 in microfiche. DOE Report No. DOE/BP/63365--1, January 1987. 57 p, 7 fig, 8 tab, 13 ref, 2 append. DOE Contract DE-AI79-86BP63365. Project No. 86-123.

Descriptors: *Fisheries, *Fish transportation, *Hydroelectric plants, *Fish management, Model studies, FISHPASS, Dams, Seasonal variation, Ice Harbor Dam, Reservoirs, Salmon, Columbia River Basin, Snake River, Reservoir mortality, John Day Dam, Lower Monumental Dam, Smolt, Turbine mortality, Fish passages.

The potential for an expanded fish transportation program is examined under an assumption of fully operational fish bypass facilities being present at mainstem Snake and Columbia River hydroelectric facilities. The U.S. Army Corps of Engineers FISHPASS model was used for the analysis. Results indicated that additional transportation would be of marginal benefit to any stocks except those entering the pool immediately above the dam being considered. For this reason, Ice Harbor Dam is least attractive for addition of transport. John Day and Lower Monumental were the most attractive as preferred locations for transportation facilities. The effect of variations in turbine mortality was very small when compared to changes in reservoir mortality. For yearling chinook, halving reservoir mortality nearly doubled survival rates while doubling reservoir mortality caused a 75% decrease in survival. In contrast, doubling turbine mortality dropped survival rates by 28% and halving turbine mortality resulted in an increase of 1.17 times the base case survival rate. Post-transport mortality vs. in-river mortality (so-called 'differential mortality') could have substantial bearing on the results of any transport analysis and was not considered in the modelling analysis. For this reason, differential mortality is discussed and hypotheses which could explain the existence of a real or apparent mortality are presented. Given the overriding impact of reservoir mortality and the current inability to effectively alter this mortality, transport appears to be worth assessing. The analysis also examined the effect of variation in parameters used in the FISHPASS model on the predicted survival of salmonids. Results indicated that variations in flow patterns within the month (day-to-day or week-to-week) did not greatly affect the results by that seasonal shifts in runoff timing (early vs. late) could have substantial impact. (Lantz-PTT)
W88-11276

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

HYDROLOGICAL SCIENCES - SOCIETY'S NEEDS,
World Meteorological Organization, Geneva (Switzerland).
J. P. Bruce.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 2, p 141-150, April 1988. 15 ref.

Descriptors: *Reviews, *Hydrology, *Management planning, *Social aspects, *Research priorities, *Developing countries, Aquatic plants, Climatology, Ecological effects, Water quality, Geohydrology, World Meteorological Organization, Research.

This review adopts the position that many practical problems in managing water systems can now be adequately dealt with because of the advances in hydrological sciences over the past few decades. Hydrologists can be proud of their achievements. If this is accepted, what is the future for hydrological sciences. It is contended that this future lies in two main directions. One is the application of existing hydrological knowledge and techniques to water problems of the developing world. Several examples are given based mainly on experience in World Meteorological Association/Technical cooperation projects. The second is an expanding the agenda of hydrological research to embrace other closely related fields. These include the seeking of better understanding of (a) the role of vegetation in the hydrological cycle especially in semiarid regions, (b) the relationship between climate systems and water resources and (c) environmental hydrology, the linking of hydrological issues with water and air quality. (Author's abstract)
W88-10490

9C. Research Facilities

CURRENT STATE AND WAYS TO DEVELOP ENGINEERING GEOPHYSICS,
For primary bibliographic entry see Field 8E.
W88-10426

HYDROLOGY IN PERSPECTIVE,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
J. C. I. Dooge.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 1, p 61-85, February 1988. 3 fig, 6 tab, 82 ref.

Descriptors: *Reviews, *History, *Hydrology, *Geohydrology, Water resources development, Technology transfer, Theory, Research.

Scientific hydrology is considered against the background of the classical development of scientific knowledge, and applied hydrology is considered in the context of the many diverse factors relevant to providing water for health and for food throughout the world. Subjects discussed include: (1) contexts of hydrology, (2) application, data, understanding, (3) nature of scientific progress, (4) alternative views of hydrology, (5) the deterministic approach, (6) statistical mechanics and system theory, (7) water-related cycles, (8) water for health (9) water for food, (10) conditions for effective action, (11) hydrology for the future, (12) micro-, macro-, and meso-theories, and (13) unification of hydrology. (Alexander-PTT)
W88-10487

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

ATHIAS -- AN INFORMATION SYSTEM FOR ABIOTIC TRANSFORMATIONS OF HALOGENATED HYDROCARBONS IN AQUEOUS SOLUTION,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W88-10137

10D. Specialized Information Center Services

TECHNOLOGY TRANSFER IN GROUNDWATER MODELING: THE ROLE OF THE INTERNATIONAL GROUND WATER MODELING CENTER,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 4B.
W88-10913

NEW ANNOTATION DATABASE FOR GROUND WATER MODELS,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 4B.
W88-10987

NEW WISCONSIN GROUND WATER CENTER TACKLES NON-POINT SOURCE CONTAMINATION WITH EDUCATION,
Wisconsin Univ.-Stevens Point.
For primary bibliographic entry see Field 4B.
W88-11034

COMPUTERIZED DATA BASES FOR GROUND WATER MANAGEMENT: THE SOUTHWEST MICHIGAN GROUND WATER PROGRAM,
Western Michigan Univ., Kalamazoo.
For primary bibliographic entry see Field 4B.
W88-11035

DATA BASE DESIGN FOR A REGIONAL GROUND WATER QUANTITY ASSESSMENT IN KANKAKEE AND NORTHERN IROQUOIS COUNTIES, ILLINOIS,
Illinois State Water Survey, Champaign. Ground-Water Section.
For primary bibliographic entry see Field 4B.
W88-11036

GROUND WATER PROTECTION PLANNING USING THE ERDAS GEOGRAPHIC INFORMATION SYSTEM: AUTOMATION OF DRASTIC AND TIME-RELATED CAPTURE ZONES,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5G.
W88-11053

10F. Preparation Of Reviews

HYDROLOGICAL SCIENCES - SOCIETY'S NEEDS,
World Meteorological Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 9A.
W88-10490

SWIFT CURRENT VALLEY: A GLACIALLY DISRUPTED BURIED-VALLEY AQUIFER SYSTEM,
Hardy BBT Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 2F.
W88-11131

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Community Health Effects of a Municipal Water Supply Hyperfluoridation Accident,
W88-10279 5F

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Acclimation of Stream-Bed Heterotrophic Microflora: Metabolic Responses to Dissolved Organic Matter,
W88-10680 2H

Acclimation as a Factor Influencing Metal Criteria,
W88-11002 5C

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W88-10359 2H

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W88-10570 5B

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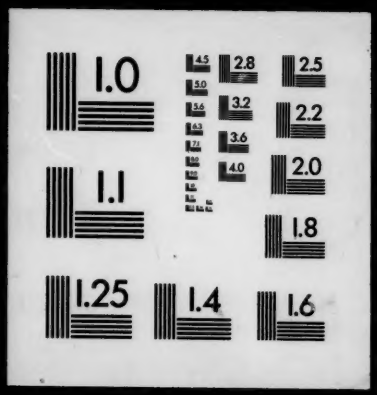

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